Heating Piping & Air Conditioning

JUNE
1959

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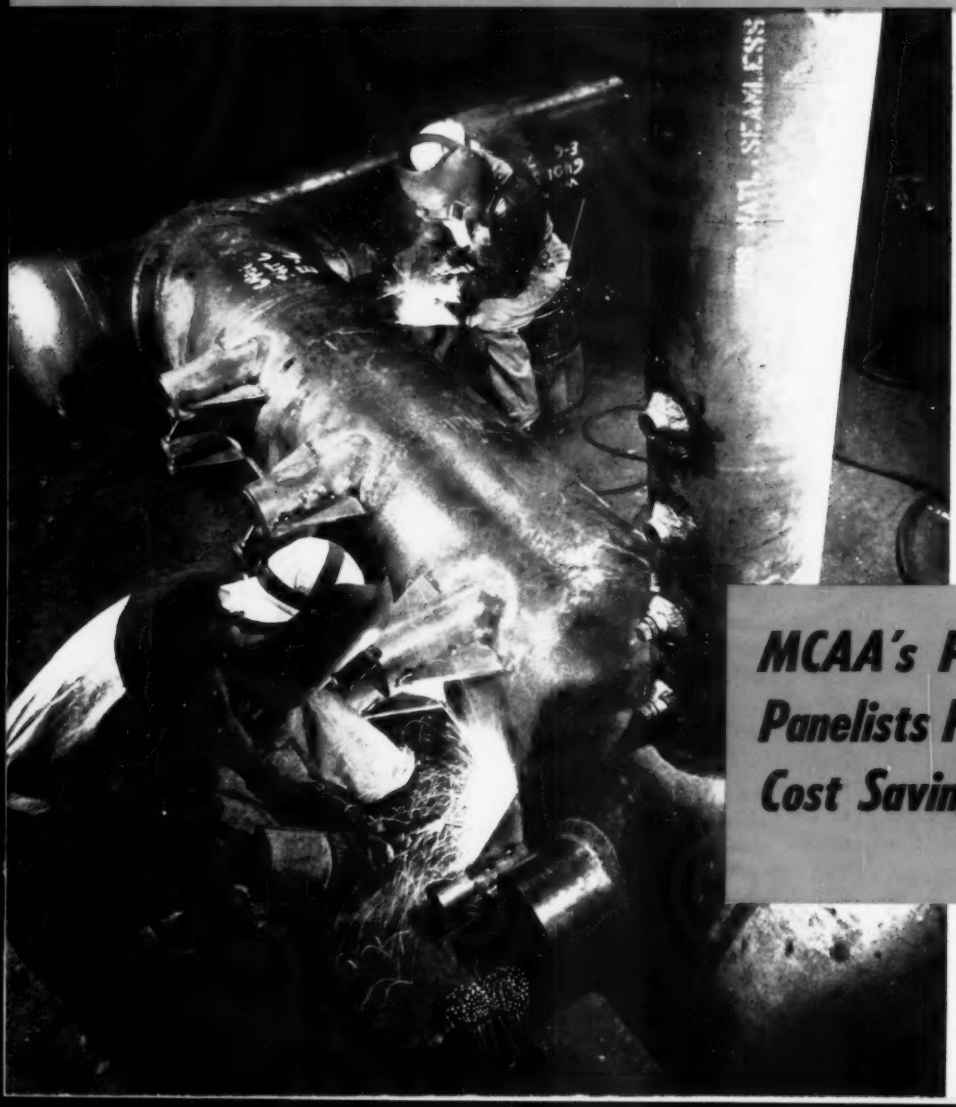
. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings



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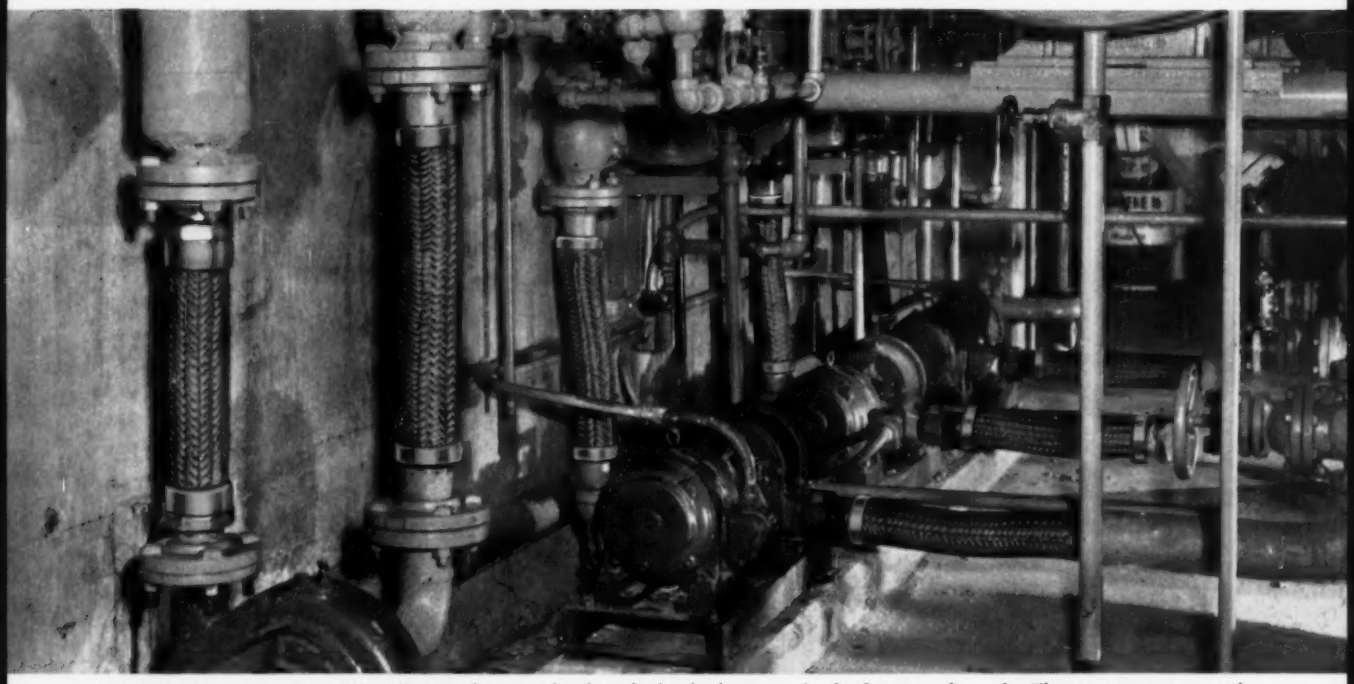
Single copy price 75c

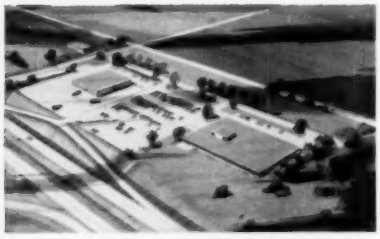
APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe



Six Flexpipe connectors, 2½" I.D., 24" long, at the three boiler feed pumps. In the foreground are the Flexpipe connectors at the hot water pump feeding Weathermaster units throughout the Administration Building of the Illinois State Toll Highway Commission.

Flexpipes made this heating and cooling system more compact, cut installation time



Artist's rendering of the Administration Building, Illinois Toll Highway Commission. Lankton, Ziegele, Terry & Associates: Architects and Construction Engineers.

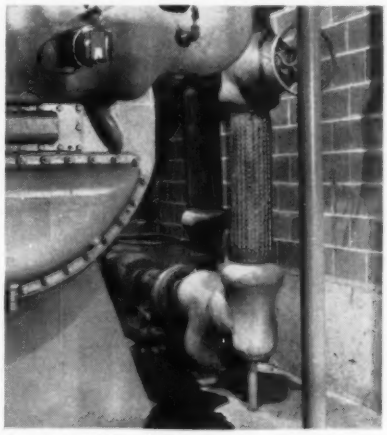
Heating and cooling systems can utilize all the advantages offered by Flexpipe connectors. Flexpipes take up movement caused by expansion and contraction in piping from wide variations in temperature. At the same time, they absorb vibration and dampen noise from pumps.

They make possible better utilization of space because they are easier to install in tight quarters and can handle offset. Note in photo above how vertical Flexpipes from boiler feed pumps saved space by making possible easy connections to piping flush against wall. Conventional piping would require considerably more work room—plus the time and cost of installing elbows, couplings, short runs of pipe, etc.

Flexpipe's flexible core can be either bronze, galvanized steel or stainless steel—I.D.'s range from ¼" through 16".

WHERE TO BUY: Leading wholesaler distributors can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

8H55



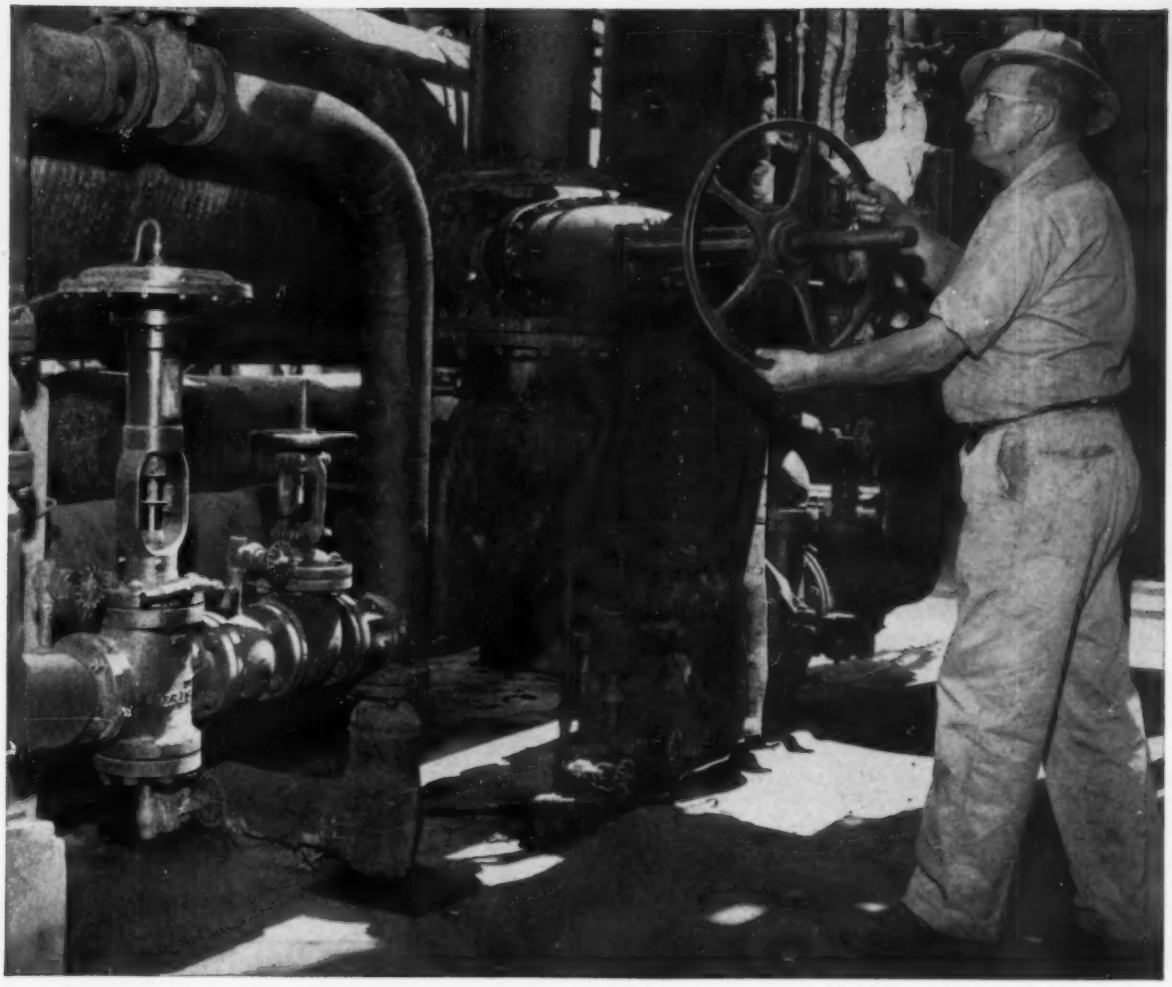
Two 8" I.D. Flexpipe connectors handle cooling water for refrigeration unit.

Flexpipe®

an

ANACONDA®

product



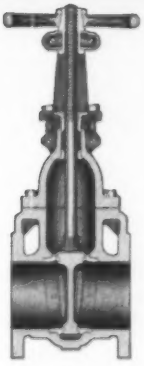
17 years on M. E. A.* solution . . . this Crane iron valve still holding tight

The facts: 17 years on hard-to-hold *Mono-ethanol-amine solution at 250 F with no leakage. No repairs or maintenance to date. Working as good as new.

That's what the Commercial Solvents Corp. petrochemical plant at Sterlington, La., reports on this 12-in. Crane No. 475½, 125-Pound, all-iron wedge gate valve. It is used as a block valve on the M.E.A. process unit, and operated on yearly turn-arounds or if a leak should develop in the unit.

This example is typical of the dependable performance of Crane iron body wedge gate valves. Their durable, low-cost service results from Crane features such as an extra number of bonnet bolts for uniform gasket loading and tight joint; full-length disc guides that save seat surface wear; shoulder-type body rings that can't come loose; extra deep, non-binding stuffing box design.

Ask your Crane Representative for more details on these better service iron body gate valves. They can save you a lot of maintenance dollars.



Cross section, 125-pound iron body gate with flanged ends, outside screw and yoke. Available in all-iron or bronze-trimmed. Line includes non-rising stem valves; also screwed and hub ends. Sizes 2 to 48 in. See your Crane catalog.

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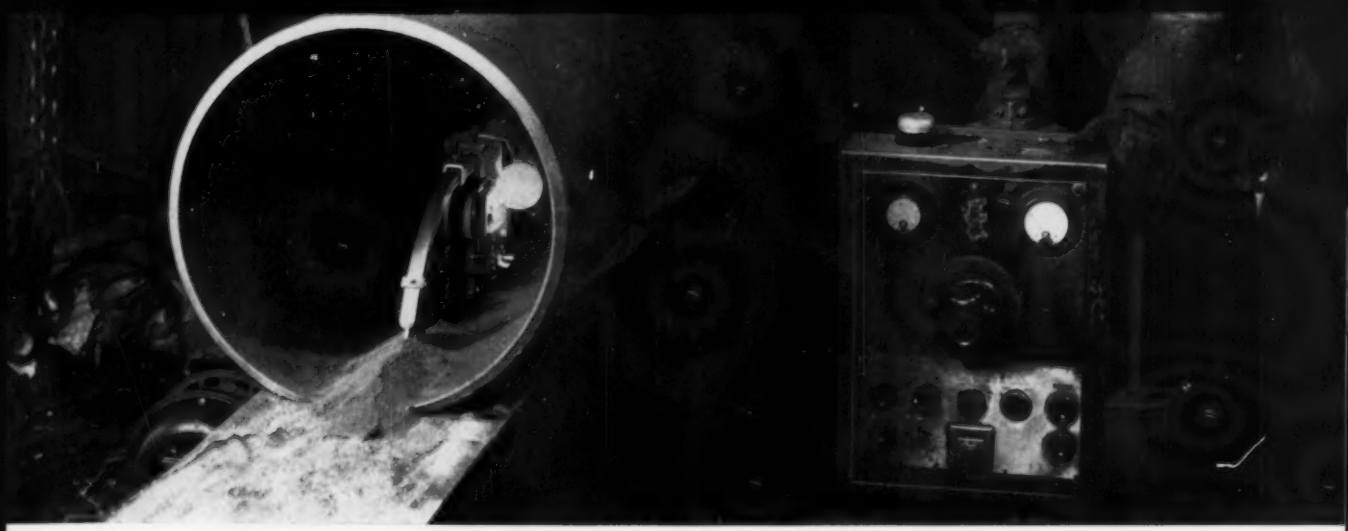
SELF-FLUXING ACTION OF 4-D WROUGHT IRON CONTRIBUTES TO SOUND, DURABLE WELDS



For superior 4-D Wrought Iron welding results, reduce your welding speed slightly below that used for steel. In electric welding, also reduce the current slightly. With oxy-acetylene welding, a neutral flame is best.

Two-Component Material—4-D Wrought Iron consists of two distinctly different components: high purity iron base metal and glasslike iron silicate. The fluxing action of the silicate protects the base metal during heating. This enables welders to easily produce sound, durable welds.

Melting Characteristics—Each of 4-D Wrought Iron's two components has its own fusion temperature. The siliceous material melts first (2100°-2200°F), several hundred degrees before the iron (2730°F). But don't confuse the fluxing of the iron silicate with melting of the actual base metal. Just continue heating until the iron fuses.

Welding Processes—4-D Wrought Iron Pipe may be easily joined through a number of commonly used welding processes: forge welding, electric resistance welding, oxy-acetylene welding, electric metallic arc, electric carbon arc and submerged arc welding, and bronze welding.

Welding Procedures—Weld slowly enough to allow the siliceous material to float out of the weld. Avoid unnecessary rubbing or agitation of the molten metal. It causes formation of oxides which may be trapped.

Fittings Available—4-D Wrought Iron welding fittings for pipe are available in a complete range of sizes, including bends, Van Stone welding stubs, reducing nipples, tees, crosses, and caps. Fabricators in many cities produce 4-D Wrought Iron welding fittings.

Bonney Forge and Tool Works, Allentown, Pa.; Heat and Power Corp., Baltimore, Md.; Ladish Company, Cudahy, Wis.; Midwest Piping and Supply Company, St. Louis, Mo.; Taylor Forge and Pipe Works, Chicago, Ill.; and Tube Turns, Inc., Louisville, Ky., manufacture extensive lines of 4-D Wrought Iron welding fittings.

Write for comprehensive welding booklet: A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

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Vol. 31, No. 6

(With which is merged the Aerologist)

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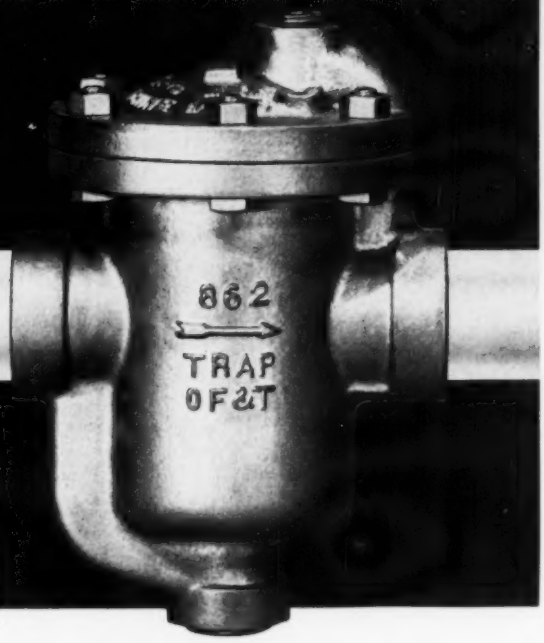
Here are the steam traps designed especially for heating systems . . .

ARMSTRONG OPEN FLOAT AND THERMOSTATIC STEAM TRAPS



Engineered for low pressure intermittent service where large amounts of air accumulate while steam is off

Armstrong O.F.&T. Traps make it possible for heating systems to deliver the efficiency they were designed to deliver. They are ideal for low pressure unit heaters, pipe coils and standing radiation.

Advantages to the user:

BIG AIR HANDLING CAPACITY—Thermic vent handles large amounts of air in system when steam is turned on. Fixed vent handles normal air in system.

NO STEAM LOSS—Stainless steel valve is water sealed, is not damaged by dirt or scale, cannot develop steam leaks.

CONDENSATE AND AIR REMOVED AT STEAM TEMPERATURE—No opening lag.

LONG LIFE—All working parts, including open float, are stainless steel. Bodies and caps designed for 250 psig operation. Open float cannot collapse.

MINIMUM MAINTENANCE—Simple, proved design and high quality materials assure trouble-free service.

Advantages to the contractor:

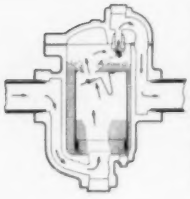
LOW COST—Mass production methods permit high quality at low cost.

EASY INSTALLATION—Horizontal, straight-through pipe connections, conventional sizes.

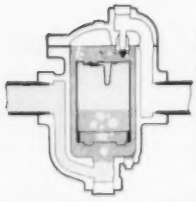
MINIMUM CALL-BACKS—Nothing to stick or clog. Unaffected by ordinary dirt.

UNCONDITIONALLY GUARANTEED TO SATISFY THE USER.

HOW ARMSTRONG O. F. & T. TRAPS WORK:



When steam is turned on, it pushes air through the wide open thermic vent and trap discharge valve at full differential pressure between supply and return lines. Condensate formed by incoming steam goes right through.



As steam reaches open float, thermostatic vent closes. Float fills with steam and rises to close trap valve. Residual air and CO_2 escape through fixed vent at steam temperature.

BULLETIN NO. 775 BULLETIN NO. 801

Use the coupon at right to get these helpful bulletins: No. 775 describes O.F.&T. traps fully. No. 801 tells how to select traps for draining unit heaters including data on 30 makes of unit heaters.

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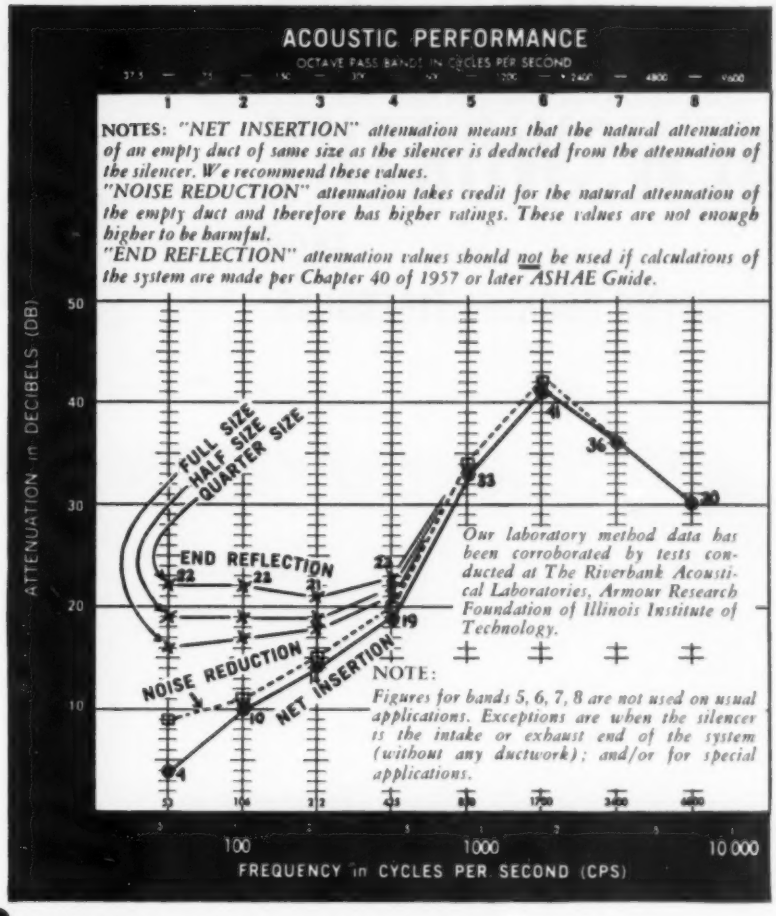
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OCTAVE PASS BANDS IN CYCLES PER SECOND
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NOTES: "NET INSERTION" attenuation means that the natural attenuation of an empty duct of same size as the silencer is deducted from the attenuation of the silencer. We recommend these values.
"NOISE REDUCTION" attenuation takes credit for the natural attenuation of the empty duct and therefore has higher ratings. These values are not enough higher to be harmful.
"END REFLECTION" attenuation values should not be used if calculations of the system are made per Chapter 40 of 1957 or later ASHAE Guide.
ATTENUATION in DECIBELS (DB)
50
40
30
20
10
FULL SIZE
HALF SIZE
QUARTER SIZE
END REFLECTION
NOISE REDUCTION
NET INSERTION
22
23
21
19
33
41
34
30
4
10
Our laboratory method data has been corroborated by tests conducted at The Riverbank Acoustical Laboratories, Armour Research Foundation of Illinois Institute of Technology.
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1000
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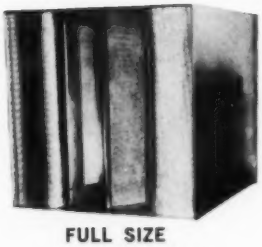

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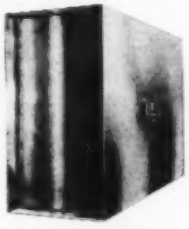

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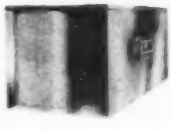

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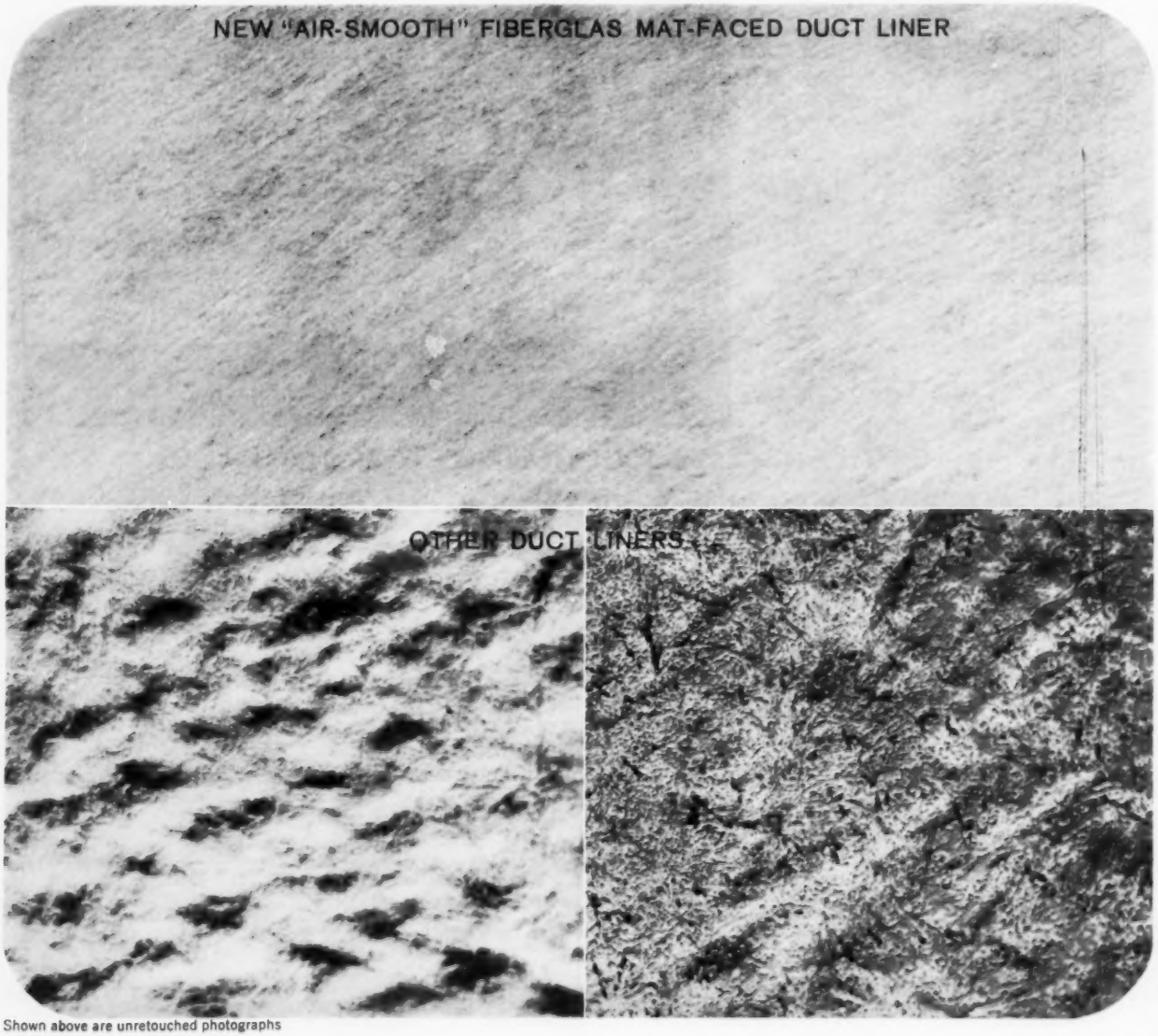

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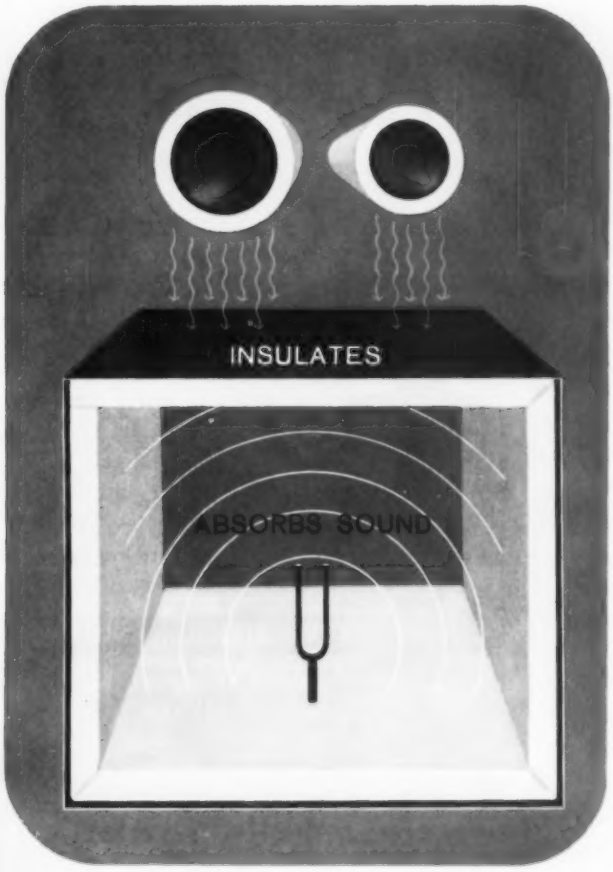

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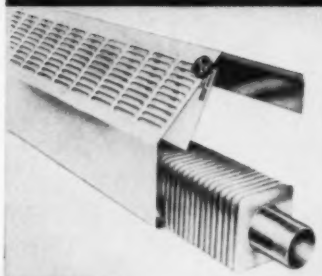

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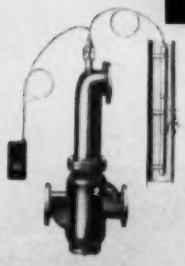
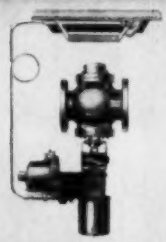


Modulating Controls for hot water and radiant heating



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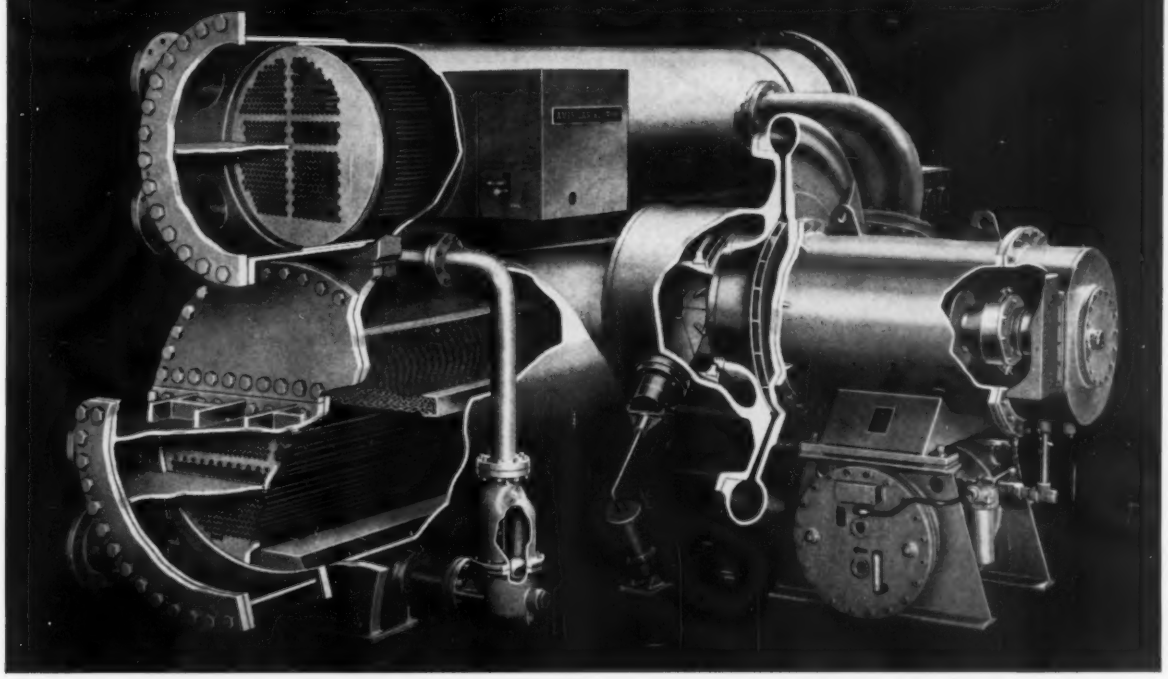

WOLVERINE TRUFIN® SAVES SPACE

provides more heat transfer surface

No finer proof of the space saving and heat transfer abilities of Wolverine Trufin Type S/T—the integrally-finned condenser tube—can be found than in its use by American-Standard Industrial Division, Detroit, Michigan.

American-Standard uses Trufin Type S/T in the evaporator and condenser tube bundles of Tonrac—its completely self-contained, hermetic, centrifugal, refrigerating machine. This single-level unit is widely-used to supply chilled water for air conditioning systems in public buildings, offices and industrial plants.

Wolverine Trufin Type S/T is of great value here, because its extended surface has approximately 2½ times as much outside surface area as ordinary, plain condenser tube. In units such as Tonrac this enables the manufacturer to pack greater heat transfer capacity into a given area thus reducing overall unit size.

If heat transfer efficiency is important to your company why not follow American-Standard's lead and specify Wolverine Trufin Type S/T for shell and tube condenser use. Write for more information or ask for the services of a highly-trained Wolverine Sales Representative.

Wolverine Trufin is available in Canada through the Unifin Tube Division, London, Ontario.

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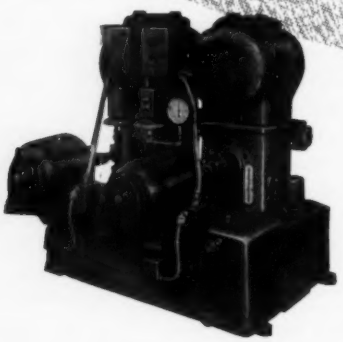

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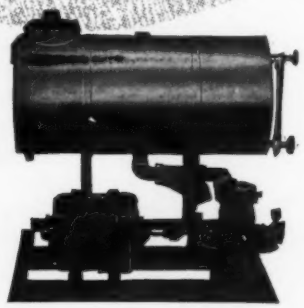

TYPE "TM" PUMP
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SKIDMORE PUMPS

SKIDMORE CORPORATION ST. JOSEPH MICHIGAN

LETTER FROM THE EDITOR

June 1959

Dear Reader:

Pipe welding is always an important subject at the annual conventions of the Mechanical Contractors Association. So it was at the recent meeting in Washington. Several new cost saving techniques were presented by panel members as reported on page 97. William E. Maloney, chairman of the pipe welding committee, pointed out that the mechanical contractor is constantly testing and conducting research in the field with new pipe metals, new and improved electrodes, field erection methods, and automatic pipe welding equipment -- all in an effort to cut labor costs and increase the safety of the worker. J. O. Cavanagh, guest on the panel, explained how to cut labor costs by using the new series 18 electrodes which eliminate the need for chipping and grinding after each weld pass. Mr. Cavanagh also reported that the 18 series electrode permitted greater deposition rates

To meet a variety of temperature, humidity, and dust control requirements in a new electro-mechanical aircraft components plant, four separate areas were planned and designed to provide the flexibility desired. Boris M. Lemos tells how these four sets of conditions are satisfied in his article on page 100. These areas may be changed at any time to accommodate some new production procedure requiring more or less critical temperature, relative humidity, and dust control limits. As the only stationary items in the building are the columns, the furred space around the columns is used to accommodate the supply and return air ducts.

To avoid freeze-up problems with air heaters in industrial ventilation systems, they must be chosen, arranged, and sized carefully, according to John H. Clarke in his article on page 104. Mr. Clarke also points out that poor fan selection can be a major cause of stratification and control problems which may lead to freeze-up of the air heaters. He says face and bypass damper control, which is frequently used as a safeguard against freezing, is often inadequate if some inherent "bugs" are not ironed out. He also says that it is most important to have the system inlets and dampers designed and located to afford uniform air flow.

To guarantee safety from carbon steel power piping failures, even when operating temperatures are at 800 F or lower, a regular schedule of sampling and examination of selected sections should be made, according to I. A. Rohrig in his article on page 108. In sampling carbon steel piping to determine its graphitized condition, other significant findings have occurred, such as cracking of internal surfaces at desuperheaters, flow meters, and drain connections. Although the piping system may appear to be in satisfactory condition and safe for operation, sampling of selected sections of the piping may reveal conditions that are not only harmful, but if allowed to continue, may result in detrimental effects making replacement necessary. By regular sampling and examination, suitable repairs can be made in time and the system maintained in a safe condition for many years.

In studying the value of air conditioning with reference to work output, absenteeism, and other considerations, the U. S. Government has concluded that air conditioning was responsible for an average increase in work production of more than 9 percent after a five month study in 1957. The results of this study, which have just been made available, are given on page 112. Other results show that there was a measureable decrease in absenteeism of about 2.5 percent in addition to an important contribution to employee comfort and morale, and "a decrease in employees' living expenses such as cleaning bills, hairdos, and makeup."

In designing a high temperature hot water heating system, careful consideration should be given to temperature-pressure control, according to G. F. Carlson in his article on page 116. He points out that, in the range of 400 F, each degree rise in temperature requires about 3 psi increase in pressure to prevent boiling. He discusses several methods of control arrangements for the HTHW system and explains how to design the system in terms of water flow balance.

New quality control requirements for fusion welds of steel welding fittings having seam welds are given in the recently revised ASTM specifications A 234-58a T, A 403-58a T, and A 420-58 T. Foster W. Holmes explains in his article on page 120 what these changes are and how they aid the user. He also summarizes the specifications in this article.

New steam pipe sizing data is given in this month's Data Sheet on pages 127 and 128. These tables contain data for sizing the steam main, and next month data will be presented for sizing the branches.

A common cause of store odor problems is the practice of locating packaged air conditioning units in or near odor sources and permitting the units to deliver this odor to the conditioned space. Albert B. Hubbard explains how this situation can be corrected in "Round 6" of his series on winning the air conditioning odor fight on page 129. He suggests that all cabinet leaks be sealed and that enough outdoor air be admitted. Mr. Hubbard presents a simple method for measuring air flow as a means to detect if insufficient outdoor air is being admitted.

Close environmental control at the Abbott Laboratories' experimental farm is essential for studying the effect of various feeds on poultry and swine, as discussed in the article by F. F. Stevenson on page 131. Because the sensible and latent heat outputs of these animals vary so widely under different conditions, a careful evaluation of design requirements was made by Mr. Stevenson before deciding on how the close temperature and ventilation control would be achieved. This analysis is presented in detail and the fundamentals of the method should be applicable to other problems where such a balance is involved. Several types of systems are used in these new facilities.

Controlling air pollution with reference to particulate emissions is the subject of this month's "HPAC Engineering Data File" on pages 137 to 152. Particulate emissions are primarily responsible for the nuisance aspects of air pollution and are generally first to be noticed. Annoying dust fall, soiling of clothing and buildings, and damage to vegetation are the signs. These emissions are the first to which engineering controls are applied. This report explains how to control these particulate emissions from industrial and commercial space heating installations, industrial processes, and power generating plants. Some of the factors to be considered in designing these control systems include the character and concentration of the contaminants, particle size and distribution, initial and operating costs, maintenance required, and value of contaminant removed. This report explains the various methods used to control these emission rates including settling chambers for large particles, centrifugal collectors, scrubbers and washers, fabric collectors for high dust loadings, electrical collectors, and various types of air filters.

How Can Fan Be Cleaned? is the question that is answered by several this month on pages 94 and 96. The replies to this question concerning a large centrifugal fan exhausting air containing sal ammonia suggest the installation of a permanent steam connection for daily cleaning, the use of suitable air filters ahead of the fan, washing the fan regularly with warm water, and installing a fan with fewer blades of the flat radial type to permit the blades to wipe themselves clean. "Open for Discussion" is on pages 87 to 90 this month. "You'll Want to Know" is on pages 37 to 44.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

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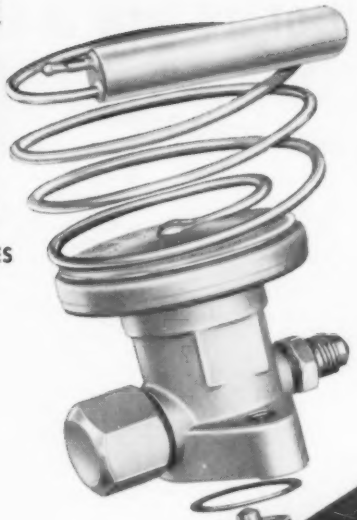

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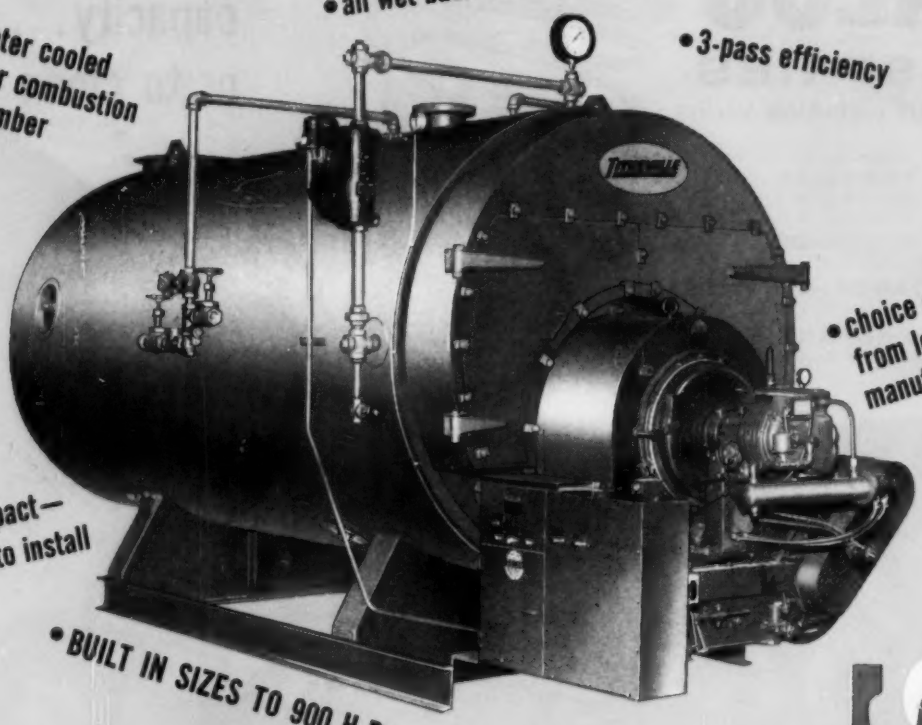
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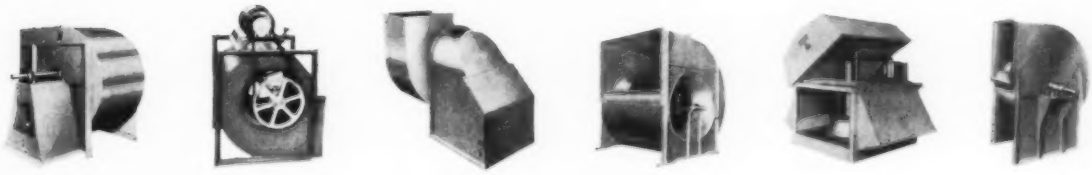

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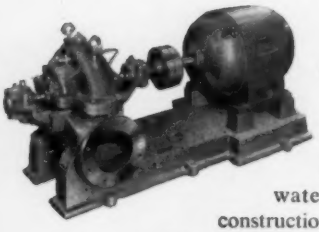
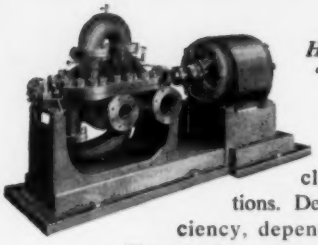
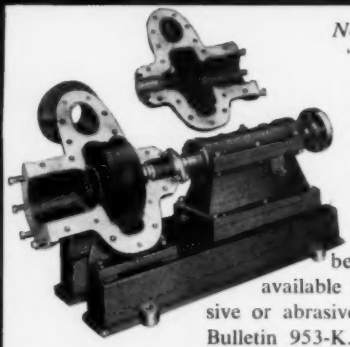


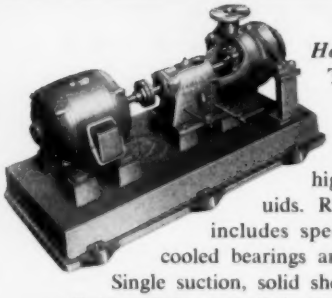
Clear Water Pumps: "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



High Pressure Pumps: "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.



Non-Clogging Pumps: "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.



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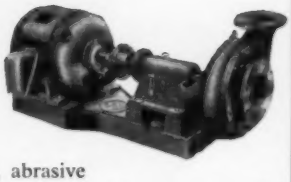

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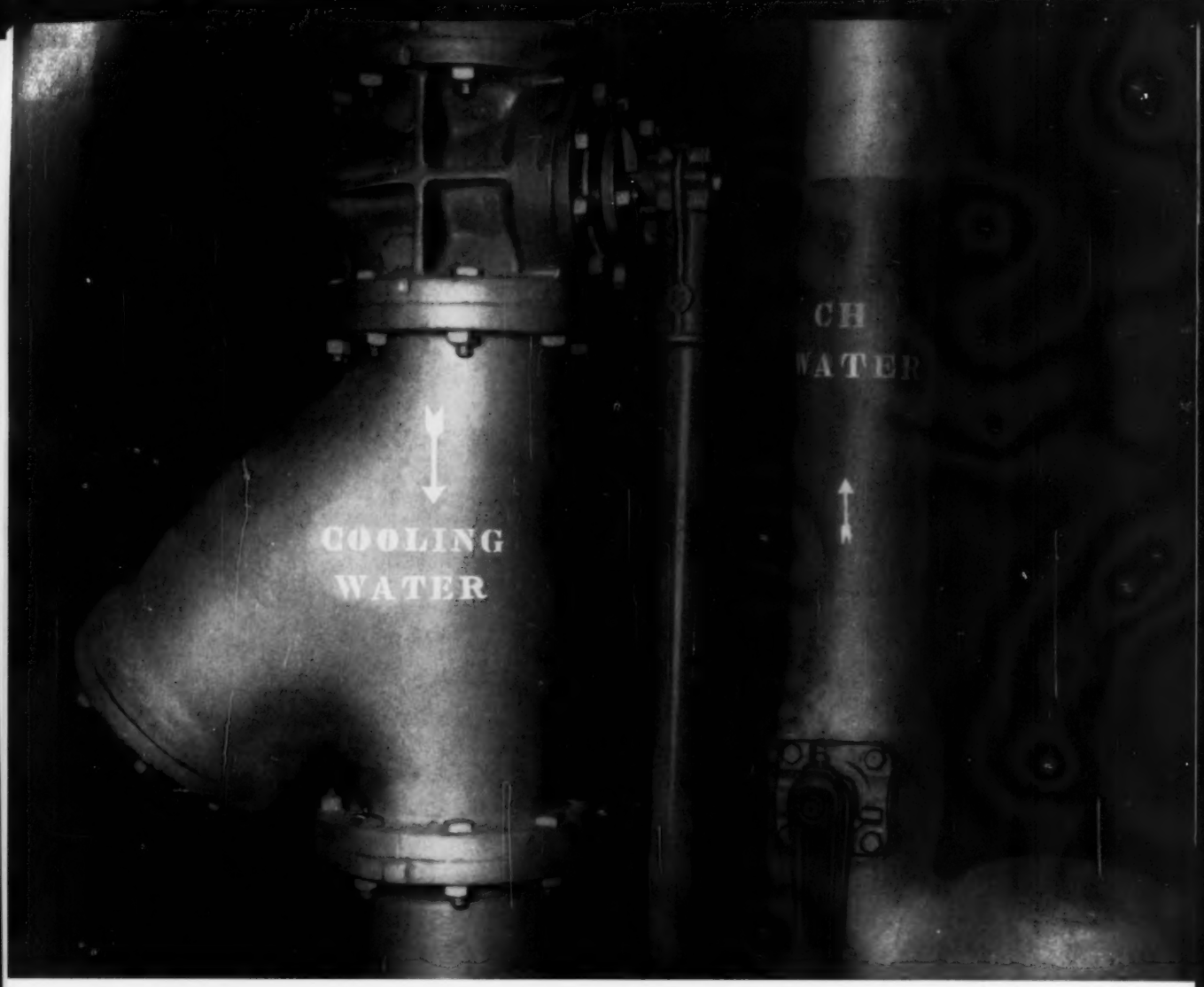

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SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

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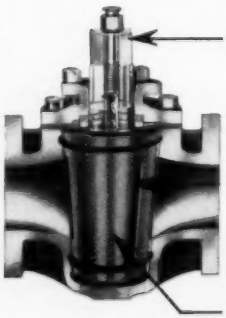

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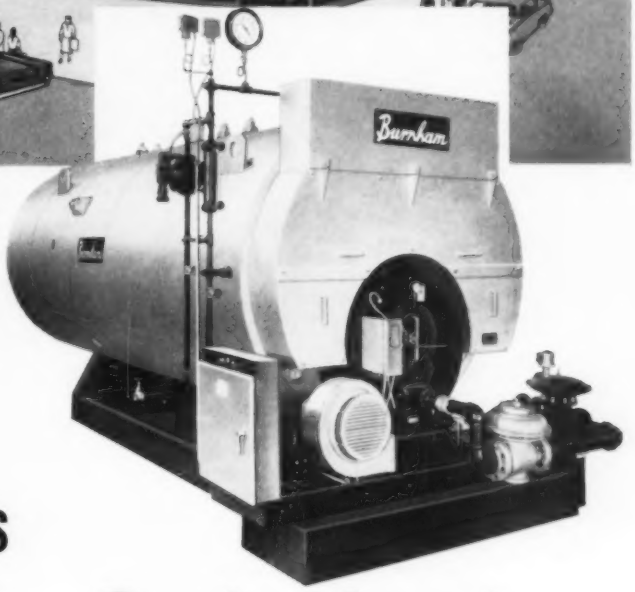
OUTSTANDING NEW DEPARTMENT STORE HEATS WITH *BURNHAM* PACKAGED SCOTCH-TYPE STEEL BOILERS



This newest branch of the May's Department Stores, filling an entire square block, will be heated with two Burnham Packaged Scotch-Type Steel Boilers of the model illustrated. Each is equipped with a gas burner having a certified rating of 261 boiler horsepower. This combustion unit was perfectly matched to the boiler after exhaustive comparative testing by Burnham.

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For full information, mail the coupon today.

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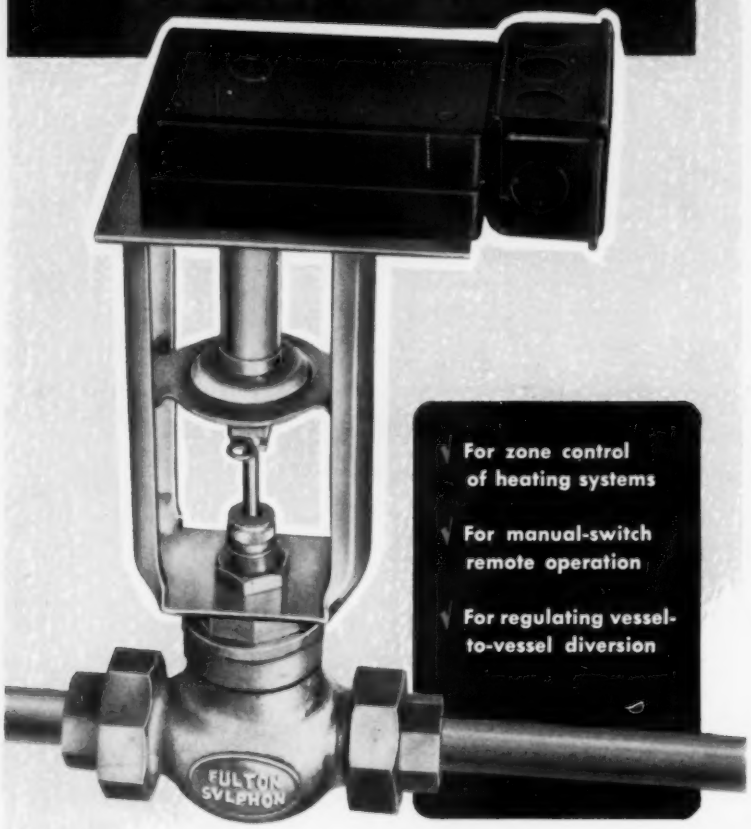


- For zone control of heating systems
- For manual-switch remote operation
- For regulating vessel-to-vessel diversion

This time-saving, work-saving unit provides inexpensive remote control where a medium-speed electric valve is required.

Sturdily constructed and use-proved, the 1230 Motorized Valve controls temperature, liquid level or flow direction when used in conjunction with appropriate thermostat, level switch, etc.

No separate transformer required. Control circuit 7 to 15 volts; all moving parts shielded; available for open or closed action, or for floating action. Sizes ¼" to 4" — larger on special order. Many valve styles available.

For complete specifications, ask for Bulletin LH-109

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

important points about joints

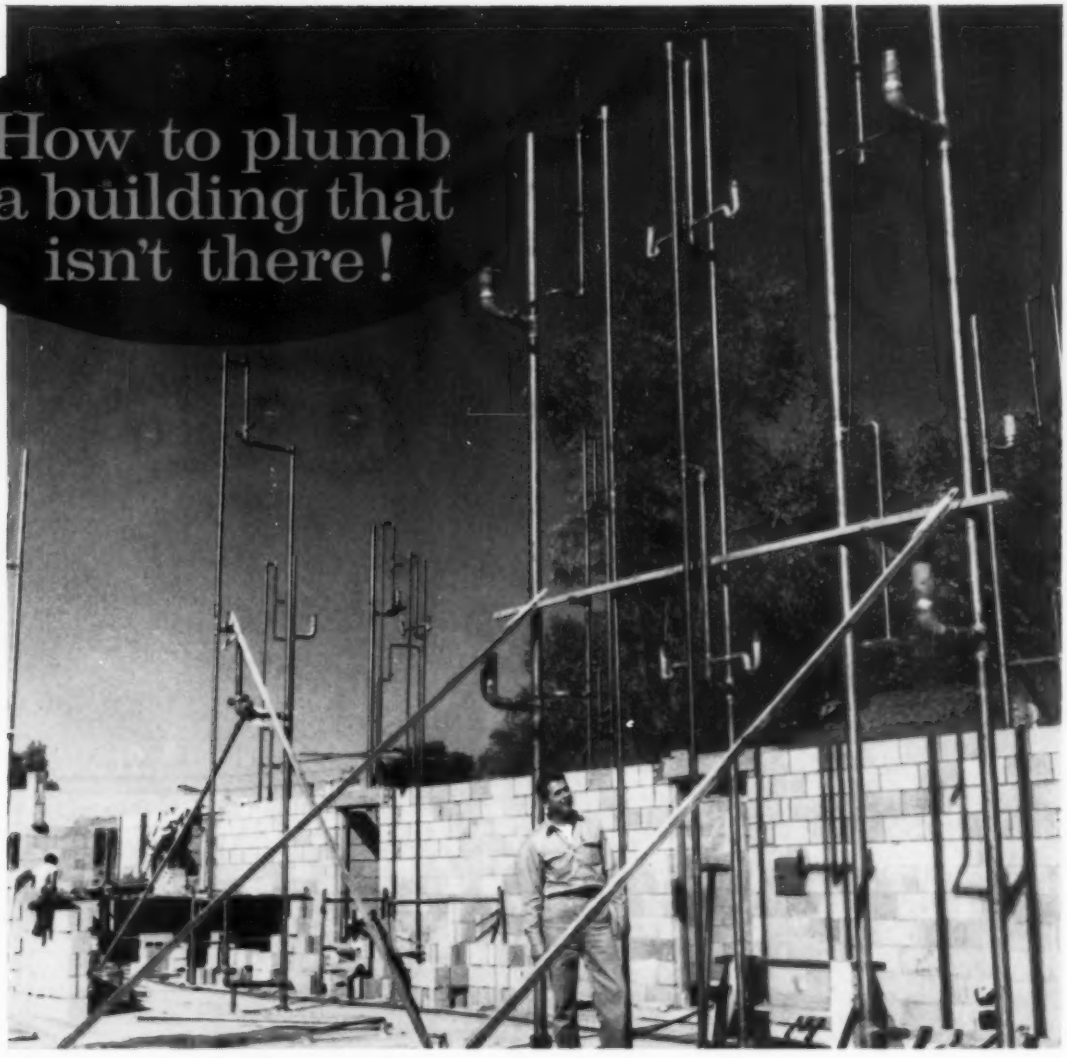
- Yarway Gun-Pakt Joints are serviced *in the line under full steam pressure.*
- Costly shutdowns eliminated.
- Maintenance records show 1 manhour per year per joint.
- Fewer expansion joints needed per length of pipeline with Gun-Pakt.

YARWAY GUN-PAKT EXPANSION JOINTS

For new Yarway Expansion Joint Catalog EJ-1916 write YARNALL-WARING CO., 107 Mermaid Lane, Phila. 18, Pa.

go YARWAY with confidence

How to plumb a building that isn't there!



...with NIBCO copper fittings

Residents of Denver couldn't believe their eyes as they watched the Alida Rae Apartment building start to go up. The foundations were hardly in place before the plumbing lines were installed.

There was no error. Joe Harris of Harris & Company Plumbing was merely using a new technique, worked out with S. W. Haan, the architect/engineer, to save space, time and money.

With NIBCO fittings from Amstan Supply, Harris employees (members of Denver Plumbers' Local #3) prefabricated a copper system for this three-story building at the shop, hauled it to location and set it up. With no bother, no fuss, they completed the entire plumbing in three trips to the site: (1) Laid underground lines; (2) Set the prefabricated "trees"; (3) Set the fixtures.

If you are interested in more details, write
NIBCO INC., Dept. J-6406, Elkhart, Indiana

SEND FOR FREE DRAINAGE CATALOG DWV-2

NIBCO

WANTED
NEW HEATING SYSTEM
...but must conserve capital
Manufacturers engaged in plant expansion or
modernization plans must have modern, economi-
cal heating system, but must conserve capital for

here is the answer...

THE DRAVO HEATER LEASE PLAN

Do you need a modern, economical heating system to further plant expansion or modernization plans, but need to conserve working capital? Then the Dravo Heater Lease Plan is made to order for you. Here are the facts:

HOW DOES THE DRAVO HEATER LEASE PLAN WORK?

Your Dravo representative, a qualified heating engineer, works with you or your engineers in setting up the optimum heating plan for your facility. Then, instead of tying up working capital, or waiting to acquire the purchase price, the Dravo Heater Lease Plan goes into effect. You get the low-cost, economical heat you need—*right away*. Dravo offers several alternate methods of spreading the cost over a three to seven year period, each tailored to meet your particular needs, with a renewal option if you wish.

WHAT ARE THE BENEFITS OF THE DRAVO LEASE PLAN?

It frees working capital for other needs that may be more immediately profitable. It actually enlarges your borrowing capacity because the Lease Plan operates independently of your own lines of credit. It allows you to have the heating you need *now*, without the necessity of waiting for more capital.

HOW CAN I GET THE DETAILS OF THE DRAVO LEASE PLAN?

Call your Dravo Heater representative, or use the coupon below.

DRAVO
CORPORATION

DRAVO CORPORATION, Pittsburgh 25, Pennsylvania
Please see that I get full information on the new Dravo Heater Lease Plan.

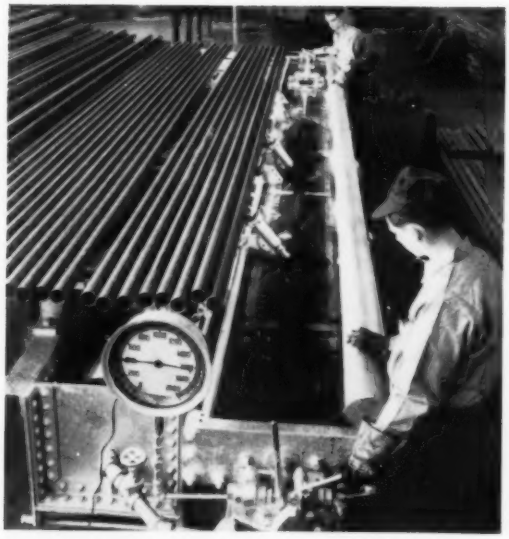
Name _____ Address _____

Title _____ City _____ Zone _____

Company _____ State _____

Architects & Engineers: L. J. Hosman and R. F. Hastings, Detroit. Consultants: Smith, Hinchman and Grylls, Inc., Detroit. General Contractor: J. H. Pomeroy & Co., Inc., San Francisco, Los Angeles. Mechanical Contractor: J. B. Nettles & Co., Inc., San Francisco. Sprinkler Contractor: Rushlight Automatic Sprinkler Co., Portland. Pipe Jobbers: Grinnell Co. of the Pacific, Los Angeles; Keenan Pipe & Supply Co., Los Angeles.

Under this 23-acre roof . . . 1,053 tons of Bethlehem Steel Pipe



Our buttweld pipe is made on modern continuous-weld mills. Each length of pipe is hydrostatically tested to assure quality.

Recently completed in East Los Angeles, here's one of the largest and most modern automobile assembly plants ever built by the Ford Motor Company. Designed for a two-shift production day—and with an eye to economy—the plant is serviced by hundreds of miles of Bethlehem steel pipe.

Experience had shown the designers that steel pipe gives the most service for the least expense. So they specified steel pipe in diameters from ¼ to 12 in. for the plumbing, heating and gas lines, for the compressed air piping, and for the automatic sprinkler system.

When you next have a piping job, you'll come out ahead if you use Bethlehem steel pipe. Beth-Co-Weld continuous buttweld pipe (up to 4 in. nominal) and Bethlehem electric resistance-weld pipe (from 5-9/16 to 16 in. OD) will help you make a profit—and will give your customer what he wants.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem Products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corp.

BETHLEHEM STEEL

BETHLEHEM STEEL

SAVE and SELL
with these
HUSSEY COPPER
TUBING ADVANTAGES

MATERIAL SAVINGS

Copper's durability—one of its outstanding properties—makes it possible to use thinner walled tube with smaller outside diameters for water lines and drainage, vent and waste systems. Result—a saving in both material and space. Its light weight permits handling of longer lengths. Result—fewer fittings. Soldered joints eliminate need for caulking, lead and oakum.

INSTALLATION SAVINGS

With copper, site work is reduced because copper is easy to handle . . . easy to cut . . . requires no threading . . . solders quickly. Its long lengths mean fewer joints and faster fitting in the tight spots. Often, plumbing trees and even complete modular bathrooms can be prefabricated to save installation time and money.

QUALITY SALES FEATURES

Copper is a "sell-word" because customers know it as the sign of quality construction. It is broadly recognized for its long service without costly replacement and maintenance in all its many uses in construction. You can be doubly sure you'll get all the quality features of the ageless metal when you specify HUSSEY —a leading name in copper since 1848.

COPPER HUSSEY BRASS

C. G. HUSSEY & COMPANY

(Division of Copper Range Co.)

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MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

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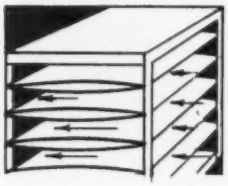
from CONNOR...

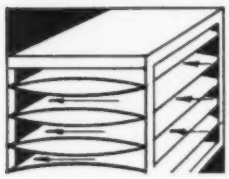
new in '58–the helical spring damper

NOW in '59
PNEUMAFOIL®

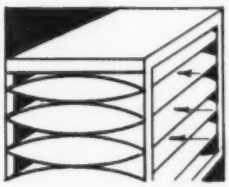
PATENT PENDING



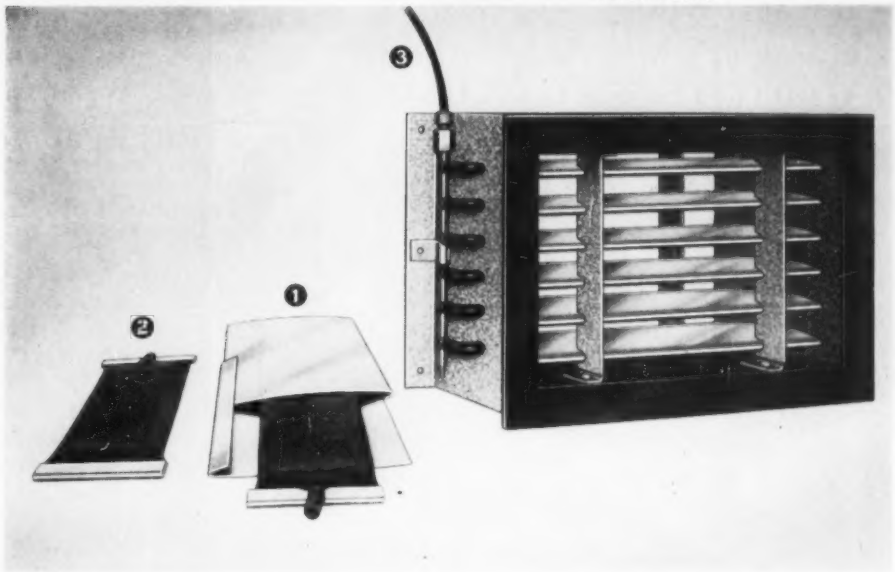
Pneumafoil has no linkage mechanism to actuate its vanes (1). Instead, each vane is occupied by a sealed neoprene actuator (2) connected to control air (3).



As air pressure is modulated between 0-15 psi, the actuator—literally lung-like in its pneumatic capacity—inflates, and expands the vanes; thereby producing throttling action by effectively diminishing the open area through which air can flow.



Achieving complete shutoff, all vanes make contact, allowing only negligible air leakage.



a pneumatically actuated high velocity air valve

PNEUMAFOIL is new in ways which are clearly beneficial to the design and function of a high velocity system, offering pronounced advantages of efficiency and economy over valves differently designed.

. . . new in DESIGN through which–for the first time–*pneumatic actuation* entirely eliminates the need for air motors and linkage mechanism in a rectangular high velocity air valve.

. . . new in CONSTRUCTION which employs streamlined air foil type aluminum vanes to minimize noise caused by air turbulence.

. . . new in CONTROL which is unprecedented in its operation directly by a standard pneumatic thermostat or constant volume regulator (both supplied by a 15 psi system).

. . . and extensive laboratory tests proved these Pneumafoil valves to have a minimum service life of twenty years!

DUAL DUCT SYSTEM ADAPTABILITY.

Available in 16 sizes, Pneumafoil also is the basic component in a new line of dual duct valve attenuators which range in air delivery from 1500 to 9600 cfm. Additionally, for fixed setting by manual adjustment, Connor offers MANUFOIL, which has a linkage mechanism and the same air flow characteristics of Pneumafoil.

For data on dimensions and capacities of this equipment, request Bulletin K-42.

Connor claims no corner on producing components of significantly advanced and beneficial design . . . but with Pneumafoil, Connor again demonstrates that its engineers constantly are developing equipment which assures the air conditioning industry and its customers of continued progress and growth.

CONNOR... for Constant Comfort Conditions

CONNOR ENGINEERING CORPORATION

DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION

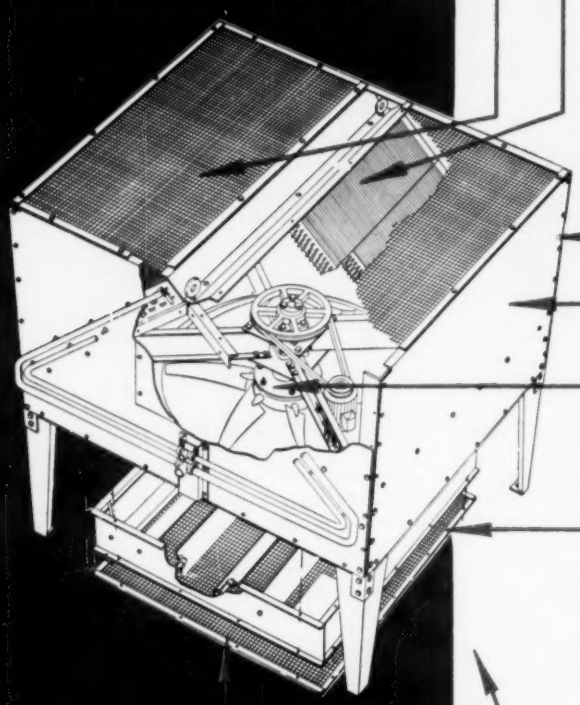
kno·draft®

high velocity air diffusers

driCooler®

AIR COOLED REFRIGERANT CONDENSERS

. . . backed by Marley's world of experience in the field of air cooled heat exchange



9 MODELS for All-Season Service
. . . designed, tested and proved by

MARLEY®

The Marley Company

Kansas City, Missouri

Write for DriCooler Bulletin today

ALL these features are in EVERY DriCooler in Marley's complete line with nominal capacities from 15 to 100 tons.

VERTICAL DISCHARGE

Most effectively dissipates heated exhaust air without recirculation; maintains operational stability regardless of wind turbulence or direction; does not affect adjacent equipment.

HEAT TRANSFER SURFACE

Uses plate type fins of aluminum to expose large surface area to air flow with low air pressure drop; copper tubes in staggered pattern are of small dimension and internal volume, requiring minimum quantity of refrigerant.

CASING PANELS AND GUARDS

Encase all sides and protect coils and mechanical equipment; shield out winter winds. Hail guard (above) and fan guard (below) are standard protective equipment. Large access and inspection panel conveniently located.

HOT DIP GALVANIZING

Applied to all panels, structural shapes and guards (*after fabrication*), protects unit from corrosion and adds years of service life with minimum maintenance; keyed to the overall durability engineered into all units.

MECHANICAL EQUIPMENT

(Including fans, bearings and motor-drives) is heavy-duty industrial type manufactured and guaranteed by Marley; thousands of these mechanical units have been in daily service for years, operating under most rigorous conditions.

DAMPER

(Optional) Practicalizes winter operation; operated by built-in automatic controls that maintain proper head pressure in low dry bulb periods; minimizes refrigerant charge; simplifies piping requirement.

LOW SOUND LEVEL

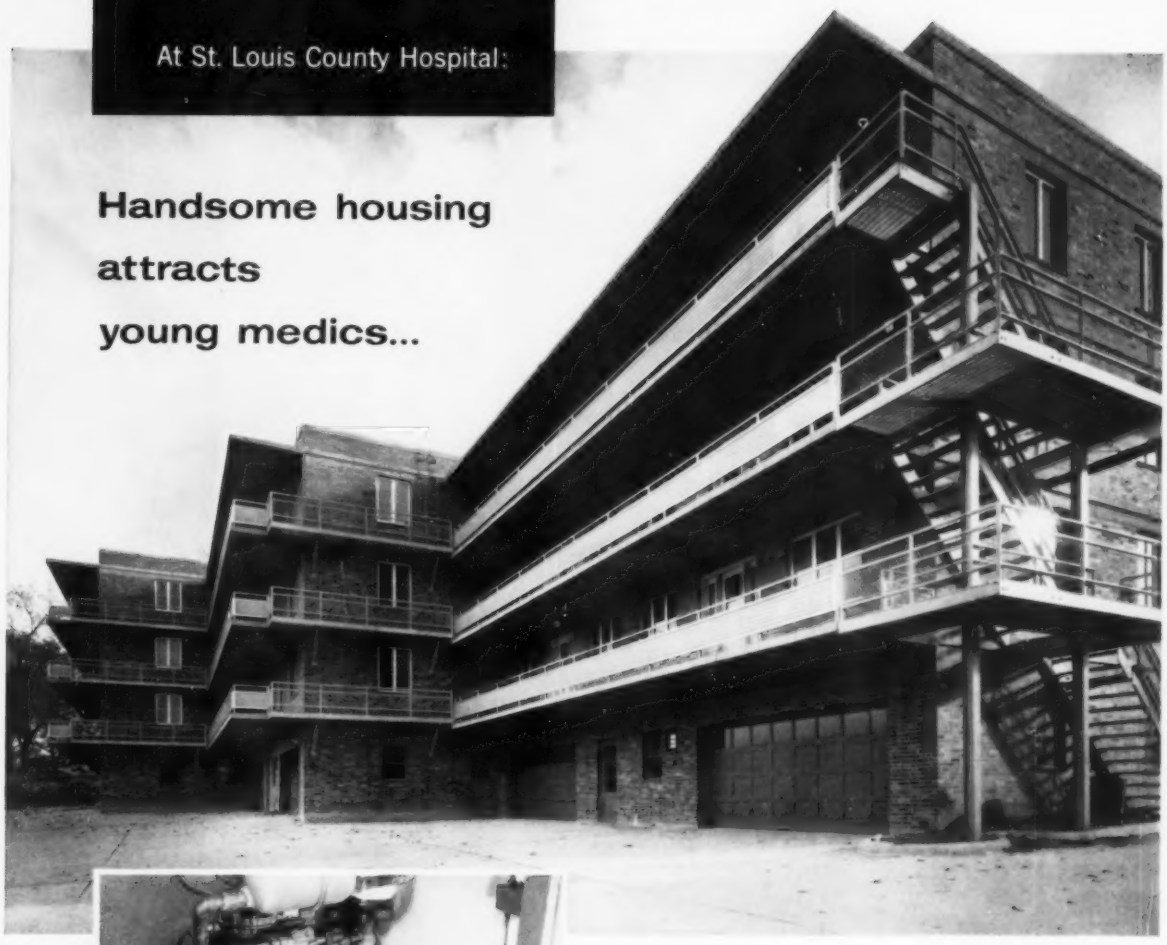
Is achieved by enclosing fan and mechanical equipment; casing confines sound; angled coil sections act as sound baffles.

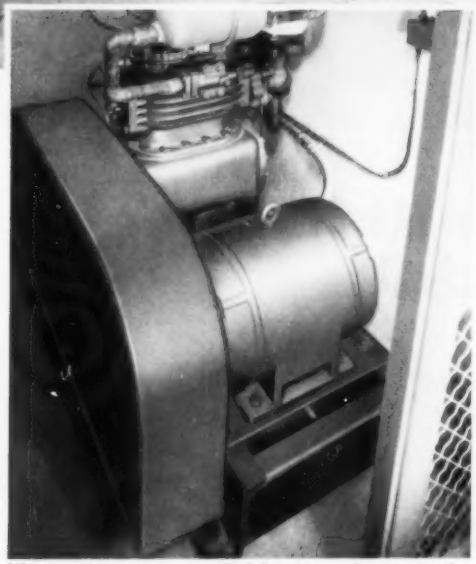
FORCED DRAFT DESIGN

Is logical method of obtaining most efficient air-flow; fan moves dense unheated air (more pounds per horsepower at high velocity); permits locating DriCooler in confined areas or behind concealing walls or parapets.

At St. Louis County Hospital:

Handsome housing attracts young medics...





Wagner Motors were specified for this application, as they are for many air conditioning installations, because they give smooth, dependable power.

Designed to attract a larger number of medical school graduates to the St. Louis County Hospital intern program, this striking 18 family apartment building offers comfortable rent-free housing to interns, resident physicians and their families.

This new structure is actually three buildings, each with a central air conditioning unit. The compressors are driven by Wagner polyphase motors. These power-packed motors start compressor loads smoothly and easily, are small in size, light in weight—easier to install and maintain.

Whatever your motor requirements may be, Wagner can supply you a standard motor or build a special motor to fit your need. Constant research and development have kept Wagner up front in electric motor design for more than 65 years—made the name Wagner one you can trust in choosing motors for your plant or for your product. Call your nearby Wagner field engineer for an engineering analysis of your next motor application. There are Wagner branches in 32 principal cities.

WM59-3

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6370 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

LIVE BETTER ELECTRICALLY

SERVING 2 GREAT GROWTH INDUSTRIES . . . *ELECTRICAL* . . . *AUTOMOTIVE*

BEFORE YOU BUY, THINK:

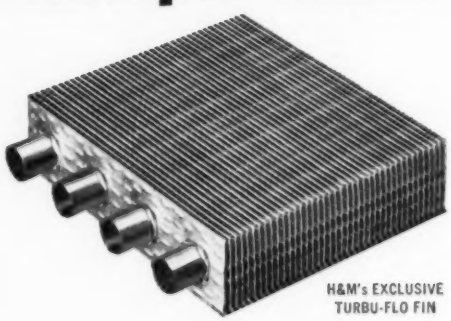
Do you need 6, 7, 8 or 10 fins per inch?

Halstead & Mitchell supplies Turbu-Flo Coils with the fin spacing you want

Why accept someone else's "standard" when your own judgment dictates another fin spacing for the specific job at hand. Now you can call on Halstead & Mitchell for Turbu-Flo coils with 6, 7, 8 or 10 fins per inch to meet your individual size requirements.

H&M makes coils for use with most refrigerants, steam (standard or non-freeze coils), hot or chilled water. All coils are available from 1 to 8 rows deep, with finned heights of 12 to 36 inches, and finned lengths up to 10 feet. Aluminum fins on seamless copper tubing are standard, though copper fins may be ordered. Casings come in heavy gauge galvanized steel or aluminum, with connections for left or right hand.

When perfect performance depends on correct design, specify H&M coils. Ask your wholesaler for complete information or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.



H&M's EXCLUSIVE TURBU-FLO FIN

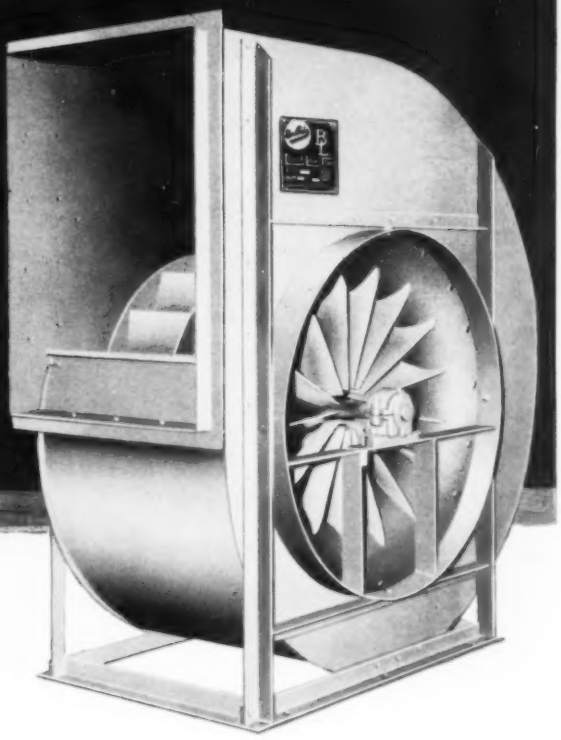
HM

Halstead & Mitchell

Finned Coil Products • Air-Cooled Condensers • Water-Cooled Condensers • Cooling Towers

EFFICIENCY
DURABILITY
QUIETNESS
+ QUALITY

"BUFFALO" TYPE "BL" for general air moving



All the things you want for satisfactory air handling at moderate pressures are embodied in the "Buffalo" type "BL" Fan. High efficiency, quiet operation and quality of construction* lead to unparalleled durability on the job. Here are several of the reasons why you will be more than satisfied with this well engineered fan:

- *Inlet* — Minimum turbulence is assured by the smoothly-curved inlet bell. Air flow is further smoothed by directional guide vanes and matching shroud.
- *Wheel* — Streamlined wheel with backward-curved blades achieves peak efficiency. Factory tested and balanced wheel minimizes vibration.
- *Housing* — Smooth air flow is enhanced by the correctly shaped scroll of the wheel-contoured housing.
- *Non-overloading characteristic* — quiet, stable output is provided from free delivery to shutoff.
- *Rugged, durable construction* — Extra-heavy at points of greatest strain and wear — gives long, maintenance-free service.
- *Highest Quality* — backed by the "Buffalo" reputation of 82 years in the air moving field.

For complete details on the "Buffalo" Type "BL" Fan Series, contact your "Buffalo" engineering representative. Or write direct for Bulletin F-104.

*Every "Buffalo" Fan brings you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE COMPANY

Buffalo, N. Y.

Buffalo Pumps Division, Buffalo, N.Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

Now!

this golden cap identifies "Freon" premium quality refrigerants*

"Freon" Products Division
E. I. du Pont de Nemours & Company (Inc.)
Wilmington 98, Delaware

DU PONT

Better Things for Better Living
. . . through Chemistry

factory sealed for purity by Du Pont

Gold-capped cylinders—the new way to identify "Freon" premium quality refrigerants. Each gold-capped cylinder of "Freon" is *factory-sealed* by Du Pont to make sure you get the high purity guaranteed by 27 years of manufacturing leadership.

Today "Freon" is so dry and pure that the published specifications for "Freon" refrigerants are the accepted standards of quality for the entire industry. Best of all, "Freon" costs no more than refrigerants that are supposed to be "just as good". So *insist on "Freon"*—the time tested, premium quality refrigerants—now identified by cylinders with the new gold colored hood cap.

FREON®
premium quality
refrigerants

*Freon and combinations of Freon- and F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

Heating Piping & Air Conditioning

June 1959

You'll Want To Know...

For news of new products, see the Equipment Developments department in this issue, and for new catalogs, bulletins, etc., see the Recent Trade Literature columns. Other news material also appears in the Who's What and the We Hear That departments. Meetings and Conventions are listed toward the back of this issue under that title, as are New Books and Reports.

NEWLY ELECTED MCAA president William P. Scott, Jr., second from left, receives gavel from retiring president, Horace E. Wetzell, Frank V. McBride, far left, new treasurer, and Joseph S. Kearney, far right, new vice president, look on.

MCAA Elects New Officers; Honors H. M. Porter

WILLIAM P. SCOTT, JR., was elected president of the Mechanical Contractors Association of America at the 70th anniversary convention held recently in Washington D. C. He has served on the Board of Directors since 1953 and was formerly vice president and treasurer of the association. Mr. Scott has been senior partner in the firm of Scott Co., San Francisco, Calif., since 1943.

The new vice president is Joseph S. Kearney. He has served on the Board of Directors since 1954 and was formerly treasurer of the association. Mr. Kearney is president and general manager of the Northwestern Heating and Plumbing Co., in Evanston, Ill.

Elected treasurer was Frank V. McBride, who has been a member of the Board of Directors since 1953. He is president of the Frank A. McBride Co., Paterson, N. J.

The recipient of the Distinguished Service Award for 1959 was H. Merwin Porter, president of Belden-Porter Co., Minneapolis. This award is presented each year to the member who has made the most outstanding contributions to the industry and to the association. The award was presented by Harold E. McGregor, Fitchburg, Mass., who received this award in 1958. Mr. Porter has been active in association activities since 1928 when he was appointed to the membership committee on which he served until 1936. He was elected to the Board of Directors in 1931

and served as a director until 1944. He also held other offices in the association during these 13 years, including the office of president in 1937.

MCAA Rejects Merger; Treats Temporary Heat

DURING THE 70th annual convention of the Mechanical Contractors Association of America held recently in Washington, D. C., several important actions were taken. One concerned the proposed merger with the National Association of Plumbing Contractors studied since the 1958 convention in Los Angeles. The proposed merger of the MCAA and the NAPC was defeated in a closed session for members only. One of the major problems reported in the study that could not be resolved was an apparent inability of the NAPC to arrive at a mutually satisfactory solution of certain key problems, including the preservation of local autonomy presently enjoyed by members of the MCAA. The rejection of the merger was also attributed to the plans of the NAPC to establish a heating and cooling division which reflected evidence of the NAPC to proceed independently of any consideration of merger of MCAA and NAPC. The resolution urged the Board of Directors of the MCAA to maintain a liaison with NAPC to confer and meet on matters of common interest.

Also in a closed session for members only it was pointed out that there is nothing in the revised Pittsburgh agreement regarding the maintenance of temporary heat which makes mandatory the manning or maintenance of these systems. Also it was pointed out that the revised Pittsburgh agreement further provides that all maintenance of temporary heat shall be at the straight time rate, except where the federal wage hour law is applicable. It was also pointed out that the contractor or owner shall have the option to determine whether maintenance of temporary heat shall be by one, two, or three shifts. Considering all these factors, the members in the closed session passed the following resolutions:

1) "That the Mechanical Contractors Association of America, Inc., at its 70th annual convention recommend to all local associations of Mechanical Contractors that they refuse to enter into any new or renewal collective bargaining agreements containing provisions which make the manning or maintenance of temporary heat systems mandatory; which require the payment of anything more than straight time wages except where the federal wage-hour law is applicable; which prescribe the number of shifts to be worked, or which contain any other provisions contrary to or not provided for in the revised Pittsburgh agreement, and

2) "That should any local union take any retaliatory action because of the adherence by any local association to the revised Pittsburgh agreement, the local contractors' association shall take any and all action it deems necessary to preserve its rights."

You'll Want To Know

Infra-Red Units Heat Structural Steel Plant

INCLUDED IN THE $750,000 plant improvement program of Bethlehem Fabricators, Inc., is the installation of a system of more than 290 gas-operated infra-red heaters, the largest in a steel fabricating plant in the U. S.

The heaters are installed in seven buildings, four of which are open-ended, and constantly exposed to the atmosphere. They replace open coke fire salamanders traditionally used in structural steel plants. The heaters are installed overhead to provide warmth throughout or in the building's perimeter, and are also attached to the sides of the buildings to spot heat the busiest areas. The overhead heaters are 21 to 30 ft above the floor depending on the height of the building trusses; the side heaters are 15 to 18 ft high. Each heater has a capacity of Btu per hr which is delivered as radiation.

UA Apprentice Contest, Instructor Training Course Set for August

THE SIXTH ANNUAL international contest for pipe fitter apprentices will be held in conjunction with the new five year apprentice instructor training course at Purdue University, Lafayette, Ind., August 10-14. The announcement of the two programs has been made by the training department of the United Association of

Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the U. S. and Canada.

Participants in the contest will be fifth year apprentices who are members of the UA, and who are winners of state or provincial fifth year apprentice contests. Only one from any state or province may enter.

The five year apprentice instructor training course will require attendance at five summer sessions, each consisting of five working days when class attendance will be required. The course will focus attention on the understanding of the technical aspects of pipe fitting as related to heating, piping, and air conditioning. It will provide opportunities for apprentice instructors to improve their own instructional and manipulative skills which in turn will aid the apprentices and therefore the entire industry.

U.S. Commerce Secretary Urges Metric Conversion

SPEAKING at the Spring meeting of the American Physical Society, Secretary of Commerce Lewis L. Strauss urged American technologists to promote the nation's conversion to the metric system of measurement.

"The problem," said Secretary Strauss, "is not to make a revolution in measurement but to direct and accelerate an evolution which has been taking place. It is a matter of becoming conscious of this evolution and giving it an assist. It is a matter of using the metric system more and more and the English system less and less.

"Naturally this evolutionary process will take some time—too much time if left to itself," he continued. "I believe that some changes, especially of large measurements, will be simple because they involve merely a matter of usage. There is no reason why we could not start measuring distance in kilometers and heavy weights in metric tons. The switch from inches to centimeters in industry will be more complicated. This changeover must be accomplished with minimal disruption."

Mr. Strauss cited the U. S. technical assistance program to aid other nations, and our increasing economic competition with Russia as two pressing economic reasons for the conversion to the metric system of measurement.

A committee to consider the problems of shifting to the metric system was recently established by the American Association for the Advancement of Science after it had approved in principle the general adoption of the metric system of weights and measurements.

AEC Issues Amendments on Radiation Exposure

THE ATOMIC ENERGY COMMISSION has issued regulatory amendments for public comment which would put into effect the latest recommendations of the National Committee on Radiation and Measurements concerning maximum permissible accumulated radiation exposures.

A principal effect of the proposed amendments, based on recommendations of NCRM published in April, 1958, would be the limitation of the lifetime accumulated radiation doses of workers in restricted areas, where radiation levels are monitored and controlled, to approximately 1/3 of the limits permitted under the existing regulation.

Maximum permissible concentrations of radioactive substances in air and water would also be revised to take account of the latest committee recommendations on internal doses. Among the changes is one relating to radioactive materials which have their principal effect on the whole body. In controlled areas, the maximum permissible concentrations of these materials would be reduced to approximately 1/3 of the concentration values previously specified for occupational exposures. For other radioisotopes, some values would be increased, some decreased, others would remain essentially the same.

For individuals outside of controlled areas, and for all persons under 18 years of age, the maximum permissible radiation doses and concentrations in air and water would be 1/10 of the recommended permissible values for radiation workers.

BCR Members Hear About New Coal-Using Equipment, Processes

APPLICATION of new coal-using equipment and processes resulting from cooperative research was the theme of the 1959 annual meeting of Bituminous Coal Research, Inc., held in Chicago recently. The concurrent "techno-sales conference" was devoted to marketing coal-burning and coal-handling equipment. Dr. J. T. Rettaliata, president of Illinois Institute of Technology, spoke on research in the coal industry's future at the annual banquet, at which John D. A. Morrow, director and consultant for Joy Mfg. Co., was given the BCR's seventh annual award.

At one of the meeting sessions, Joseph W. Mullan, district engineer for the Bituminous Coal Institute, described how the BCR stack spray can control stack emission when blowing tubes or blowing soot. The spray is a water nozzle mounted in the stack to give coverage of the stack's cross-section. It is turned on during soot blowing to knock down solid particles entrained in the flue gases, depositing them at the base of the stack.

Sanders A. Frye, of Otterbein College, Westerville, Ohio, explained

You'll Want To Know

how three automatic steam generator units — comprising boiler, stoker, controls, fans, ash conveyors, and auxiliaries — placed in operation early last year had "solved the college's heating problems." Connected load is some 16 million Btu per hr, and the units provide for future expansion and standby.

In a statement at the conference, R. L. Ireland, chairman of the executive committee of Consolidation Coal Co. and president of the Bituminous Coal Institute, called electric heating "an ally rather than a competitor" of bituminous coal, referring of course to the utility coal market.

L. C. Dubs, president and general manager of Canton Stoker Corp. — in his talk at the conference — outlined the following factors a manufacturer should consider before building new coal-burning equipment:

The price range; potential volume; method of marketing; cost of developing, engineering, producing and marketing the product; how the product will fit into engineering, production, and sales; what additional advertising will be needed; the nature of competition; adequate plant capacity; sufficient and experienced plant personnel; effect on present products; need for additional capital and financing; capable and sufficient executive and junior executive talent; and profit needed to justify the venture.

Among the suggestions for industry research given by Dr. R. L. Savage, vice president of research of North American Coal Co., at the meeting was improved transportability of coal by pipe line, either by hydraulic or pneumatic methods.

You'll Want To Know

Cite New Developments in Industrial Ventilation

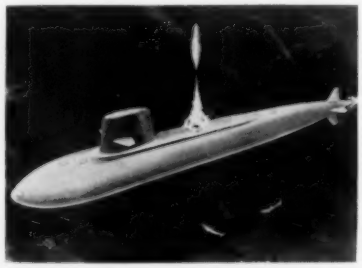
SPEAKING at the recent Industrial Health Conference, George M. Hama, Detroit department of health and chairman of the Industrial Ventilation Committee of the American Conference of Governmental Industrial Hygienists, reviewed four recent developments in industrial ventilation.

One of these was a new exhaust hood for grinders. This new hood has slot intakes near the top of the grinding wheel. The purpose is to capture the particles that would normally follow the wheel until striking the work piece. These particles ricochet off the work piece into the operator's breathing zone producing undesirable dust concentrations at this piont. Results have been satisfactory although additional development is required, he said.

The second development is a low volume, high velocity exhaust system for portable tools that has been used recently in England. A high velocity intake — slot velocities may be as high as 7000 fpm — is mounted on the tool near the working area. Small diameter flexible hoses no larger than electrical or pneumatic lines connect the intake to the central exhaust duct. Air flow rates vary from low values of 5 to 10 cfm to as much as 250 cfm depending upon the operation being controlled. System pressure drops range from 1 to 10 in. Hg (13 to 120 in. of water gage). The advantages of the system are the portability of the small diameter ducts, reduction of air cleaning equipment size, and lower heat losses associated with the discharge of exhaust air. High pressure losses and the blower size necessary to meet the service are the major disadvantages, he said.

Another exhaust device which shows promise of reducing internal pollution from foundry and other metal melting procedures, is a portable hood for pouring ladles. The key feature of this innovation is a sliding connection between fixed ducts and those that move with the travelling crane, he said. The sliding connector moves over the slots in the stationary duct. A suitable fabric prevents leakage through inactive openings.

The fourth development reported was a packaged activated carbon adsorber for recovery of dry cleaning solvents. This package unit includes the auxiliaries necessary for manual recharging of the charcoal bed, con-



Air Condition New Missile Subs

AIR CONDITIONING is one of the essential requirements for the effective operation of the new nuclear-powered submarines. Their full potential can be realized only if the atmosphere for the craft's officers and crewmen is habitable. No air can be exhausted in tell-tale bubbles, so it must be continuously cleaned and purified.

For this operation, each of the first five 380 ft undersea ships capable of launching Polaris missiles will use five reciprocating type chilling systems designed to provide a total of 300 tons capacity, according to Carrier Corp.

Continued Rise Seen in Plastic Pipe Market

SPEAKING AT THE Central Supply Association's recent spring meeting, George H. Reed, chairman of the Plastic Pipe Research Council of the Society of the Plastics Industry, Inc., detailed the existing and potential market for industrial uses of plastic pipe.

Mr. Reed noted the progress of the plastic pipe industry since its inception in 1940, and forecasted a market at a consumer level of $90,000,000 in 1960.

densing equipment for condensing steam and solvent vapors, and the separator for recovery of the solvent from the water-solvent mixture. Air is exhausted from the cleaning room (integral fan capacity is 700 cfm) and discharge through a damper into the charcoal bed. It passes through the bed, through a second damper, and is then discharged to the outdoors. During the charging cycle the dampers close and steam is passed through the charcoal bed. The steam-solvent mixture then enters the condenser and separator. The charcoal bed can adsorb about 15 gal of perchlorethylene. Recharging requires about one hour and he said it must be done once a day with heavy usage.

He cited measured performance of an existing installation in which the concentrations entering the adsorber were 56 to 350 ppm by volume with leaving concentrations of 0.1 to 0.2 ppm. At the same time, concentrations in the work room averaged 0.13 ppm. The system will reduce the air pollution contributions of this industry and at the same time recover a valuable commodity. He said that it permits the use of a better cleaning solvent at a lower cost than is now obtained with less expensive, less efficient cleaning solvents that are discharged to the atmosphere. Because of these advantages, it is attractive to the dry cleaning industry.

Construction Costs Now Give Greater Value

INDUSTRIAL COMPANIES are getting more construction for their dollar as the result of new techniques and materials, says Joseph B. Hoffmier, vice president in charge of construction for the Wigton-Abbott Corp., engineers and constructors of Plainfield, N. J.

According to Mr. Hoffmier, the construction industry is making enormous advances in achieving greater productivity and cost reduction. Certain phases of work," he stated, "have been eliminated through the use of plastic pipe and fittings and glass pipe for process piping systems, plastic ducts and introduction of larger self-contained assembly units."

Development of lighter and more mobile equipment in the past decade has helped to cut construction costs by making it possible to erect a plant in a shorter period of time with substantially less manpower. And through the comparatively recent development of plastic enclosures and using unit heaters in conjunction with construction work, it is now possible to work through the winter months without exposing workers to the discomfort of inclement weather.

Pulse Pump Studied at Batelle

A PLASTIC MODEL of the pulse pump, above, is now under study at Batelle Memorial Institute. Principles of the pump, which was designed and built at the research center, are being investigated for possible use in gas or vapor pumping systems. Here, Carl F. Speich watches the flow of smoke drawn through the left duct and blown out the right one. The shape of these vaned passages creates "aerodynamic valves" conducive to one-way flow. A diaphragm about the size of a half-dollar is located at the center of the back wall of the chamber. Acoustic frequency, in this case supplied by the diaphragm, causes the smoke to move out of the duct on the right. A transparent panel in front of the ducts completes the enclosure of the pump chamber. Batelle scientists say that a pulse pump could be further simplified if the pulse of an intermittent flame were used to supply acoustic energy

Construction Costs Up 1 percent; to Continue Climb

ALTHOUGH CONSTRUCTION costs advanced only one percent in the past six months, probably due to cold weather and the off season character of the market, costs are expected to be 4 percent higher by next April, according to F. W. Dodge Corp.

Of the two major components of construction measured (materials and labor at the site of construction), labor has again exhibited the greater strength. In the 6 months ending April 1, building material prices to builders have not changed in 93 of 143 major reporting cities and their environs. Slight decreases are reported in 12 other places and in 38 areas prices are a little higher.

You'll Want To Know

274 Separate Console Units Air Condition New Dormitories at Offutt Air Force Base

YEAR 'ROUND comfort of Air Force personnel is the goal set in the air conditioning of three new dormitories now under construction at Offutt Air Force Base, Neb.

Some 274 separate console fan-coil air conditioning units, utilizing heated and chilled water, will air condition the dormitories, according to Drayer-Hanson, Div. of National-U. S. Radiator Corp. and the Ray Goodwin Co., Omaha.

Heat will be supplied through a central steam plant, convertors, and centrifugal pumps. Chilled water will originate from packaged water chillers located in each dormitory; chillers will have rated capacities of 63, 70, and 81.9 tons. Heat consumption for each building will be about 1,500,000 Btu per hr.

The dormitories are divided into two zones, each controlled by an outside thermostat with a high limit room thermostat which resets a submaster insertion thermostat. The submaster positions a three-way valve which mixes return and heated water to maintain a set temperature. Outside air enters through the fan-coil unit and is manually controlled.

The architect and engineer for the installation is the Leo A. Daly Co. The heating, piping, and air conditioning contractor is J. H. Martig Co.

Brass Mill Imports Pose Threat to Industry Labor

UNLESS CHECKED, the rapidly increasing tide of brass mill product imports can mean the displacement of U. S. brass mill labor with low cost foreign labor, warned T. E. Veltfort, managing director of the Copper & Brass Association.

Speaking before the Copper & Brass Warehouse Association at its annual convention in Pebble Beach, Calif., Mr. Veltfort went on to point out that importers of foreign brass mill products can undersell domestic producers because wage scales are a fraction of those in the U. S. Moreover, facilities in the foreign mills are quite up to date, he assured the convention.

Mr. Veltfort's remarks on imports were part of an address on ways that the brass mill industry, which he represents, and the copper and brass warehousemen can work together more effectively.

You'll Want To Know

Panel Disagrees on 'Or Equal' Clause in Specifications

NO AGREEMENT was reached on whether the "or equal" or the "base bid" type of specification is preferable, at a panel session on the subject held during the third annual convention of the Construction Specifications Institute in Chicago last month. Members of the panel expressed divergent views on the question; unfortunately, the discussion had to be cut off to allow members to visit an exhibition held in conjunction with the convention.

Kenneth M. Wilson (of E. F. Klingler & Associate), a panel member, said that each building product has its own individual characteristics. Architects and engineers must recognize this, and must take advantage of every single characteristic of a product or piece of equipment to achieve economy in building. "We have outgrown the 'or equal' clause," he stated.

His firm uses the base bid specification, as described in his article in the May 1956 Heating, Piping & Air Conditioning. With such a specification, the items of equipment are "concisely described, their performance defined, and the manufacturer's name and catalog designation clearly set forth. If other brands of equipment are to be offered in a bid, they must be done so on an alternate proposal," said Mr. Wilson in his 1956 article.

Donald G. Scripture (of Scripture & Psihas), another panel member, did not agree with Mr. Wilson, said that the "or equal" clause has a very definite place in mechanical specifications because the engineer "doesn't have time to evaluate all the characteristics of all available products."

He pointed out, however, that the "or equal" clause should be used intelligently and not indiscriminately. Choice of a product should be under the control of the engineer or the architect at the time the bids are submitted, he said — not afterwards. He didn't feel it possible to make a blanket statement either for or against the "or equal" clause.

It was pointed out at the meeting that there are many points to consider in determining whether or not one product is "equal" to another, including the owner's maintenance cost, accessibility for service, the manufacturer's reputation and service, the quality of his local representation, etc.

An architect member of the audience engaged in public work said that contractors must furnish the specified quality under price competition, and that substitutions must not be permitted after bidding, "as the product of different quality has not been subject to competitive bidding."

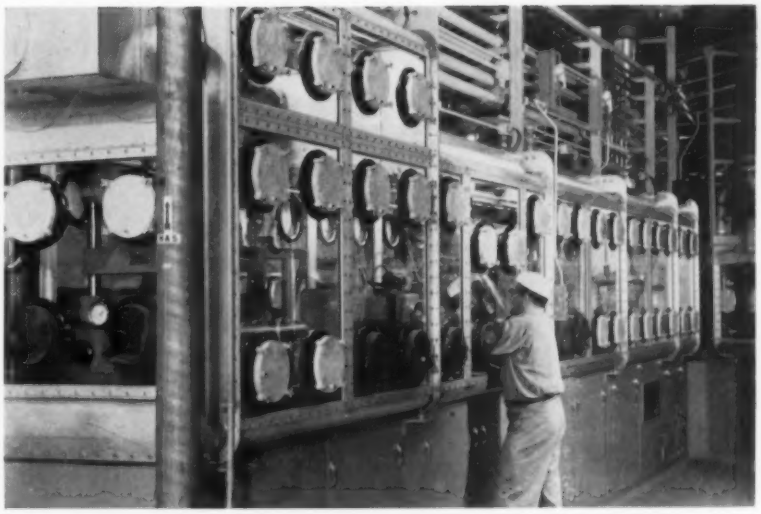
T. C. Alexander New President of RACCA

T. C. ALEXANDER was recently elected president of the Refrigeration and Air Conditioning Contractors Association by its board of directors, acting upon the resignation of Charles L. Walling due to ill health.

Mr. Alexander, formerly first vice president of the Association, is president of the T. C. Alexander Co. of Denver. He has long been active in RACCA affairs and activities, and has served as chairman of the convention and yearbook committees in 1958.

New Contracting Firm Formed in Cleveland

A NEW firm, the Reliance Co., was recently formed in Cleveland. The new company will have Sam H. Givelber as chairman of the board; Hyman R. Weiner as president and chief executive officer; William F. D. Neiheiser as vice president; Fred Gevelber as secretary-treasurer; and Joseph Levin as chief engineer and assistant secretary.



Use Helium Chambers in New Plutonium Fabrication Facilities at Argonne Lab

DEDICATED last month was the new plutonium fuel fabrication facility at Argonne National Laboratory near Chicago. This new facility will be used to fabricate experimental plutonium fuel elements for nuclear reactors at Argonne.

Because plutonium is highly toxic, radioactive, and pyrophoric, the fabrication must be accomplished in an inert atmosphere. To protect operating personnel, an integrated system of glove boxes containing a helium atmosphere is gasketed together to prevent air leakage. There are 106 glove boxes in the building.

The helium is supplied through two separate stainless steel piping circuits. One is a recirculating circuit handling either 1000 or 2000 cfm, and the other is a regenerative purifying circuit handling 100 cfm. A normal operating pressure of −0.6 to 0.8 in. water gage with reference to the room pressure is maintained in the glove boxes. All piping and ducts are stainless steel with welded joints.

March Construction Continues Climb

INCREASED ACTIVITY in housing boosted construction contracts in March in the U. S. (except Alaska) to $3,339,934,000, up 23 percent above March 1958 and a new record for the month, F. W. Dodge Corp. recently announced.

Contracts in the non-residential building category in March amounted to $913,222,000, down 6 percent compared to March 1958. While contracts for commercial buildings were about the same as March 1958, contracts for hospitals and social and recreational buildings registered gains.

Cumulative total of contracts for the first quarter of 1959, with the percentage changes from the like period, showed: non-residential contracts at $2,426,805,000, down 2 percent; residential contracts at $3,627,761,000, up 11 percent; heavy engineering contracts at $1,895,039,000, up 12 percent; and total construction at $7,949,605,000, up 18 percent.

You'll Want To Know

12 Centrifugal Fans Support Army's Pentadome

THE Army's new Pentadome structure is supported by 12 centrifugal fans, designed to hold up the air-supported structure even in constant winds up to 70 mph, according to Peerless Electric Co.

Designed to serve as a missile maintenance center, the Pentadome is made up of five hemispherically shaped, air-supported structures, which can be erected individually or as a unit in only two days. The main dome is 150 ft in diam and 85 ft high, and is the largest air supported structure ever built for military use. The four smaller domes are 100 ft in diam and 50 ft high.

Each of the 12 centrifugal fans that support the system has a maximum discharge of 22,000 cfm of free air. They provide a maximum static pressure of approximately 2.5 in. water gage, or about 0.09 psi. Under normal conditions, the shape of the structures can be maintained with a pressure of about 0.03 psi.

The number of fans in operation at any one time depends on wind speed and ventilation conditions. With little wind and low ventilation requirements, two or three fans provide the required air pressure. The fans are located in the equipment area outside the main dome and are operated from the control room inside the main structure.

46 Companies Sign ARI Contracts for Unitary Certification Program

A NEW Directory of Certified Unitary Air Conditioners, listing 1425 models of 38 of the 46 companies participating in the new ARI-National Warm Air Heating and Air Conditioning Association Unitary Air-Conditioner Certification Program, has just been published by Air-Conditioning and Refrigeration Institute.

In addition to the companies whose models are listed and rated under ARI Standards, eight other manufacturers have signed contracts to participate in the program; their certified models and ratings will appear in subsequent issues of the Directory, scheduled for publication July 1 and October 1.

The 46 companies which have now signed contracts to test and rate their unitary models according to applicable ARI Standards represent well over 80 percent of total industry shipments of unitary equipment. The top capacity of units in the program is 135,000 Btu per hr.

You'll Want To Know

Honor Lauer, Thorndike at Annual ARI Dinner

TWO PIONEERS in the air conditioning industry were honored at the recent annual meeting of Air-Conditioning and Refrigeration Institute at Hot Springs, Va.

Stewart E. Lauer, former president of York Corp. and chairman of the board of York Div., Borg-Warner Corp., together with K. B. Thorndike, who retired this spring as vice president of Detroit Controls Div., American-Standard, were presented with engraved silver bowls at the Institute's annual dinner. On each of the bowls, the following inscription appeared: "Presented by the Air-Conditioning and Refrigeration Institute, in Grateful Appreciation of Long Years of Service to the Industry."

Results of the ARI's election of officers were also announced at the annual dinner. Rudolf G. Berg, vice president of Copeland Refrigeration Corp., is the new ARI president. The three new vice presidents are: Russell Gray, vice president of Carrier Corp.; L. N. Hunter, vice president of National-U. S. Radiator Corp.; and R. K. Serfass, general manager of the air conditioning division of Westinghouse Electric Corp. The new treasurer of ARI is W. H. Aubrey, vice president of Frick Co.

down
from
the
Frozen
North
comes

UCON

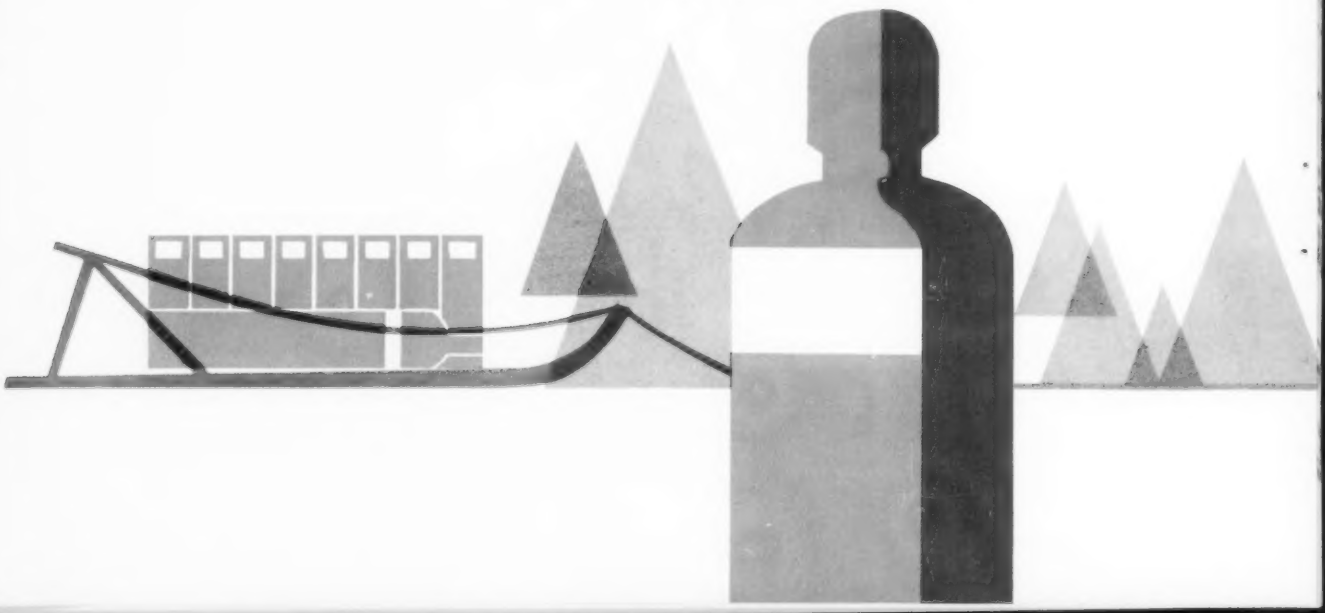
IKE

The most fabulous refrigeration expert of them all!

Meet
UCON IKE

Here's Ucon Ike, representing new Ucon Refrigerants. He's a friendly fellow, a helpful guy who really knows refrigerants (it gets mighty cold in the far North). He's resourceful, too... willing to try new ways of doing things. (Example: who but Ucon Ike ever tamed a moose before? Discovered one moose-power far outpulls eight dogpower!) Take a good look at him, because he'll soon be one of the most familiar faces in the industry.

We think you'll enjoy knowing Ike. He *is* Ucon Refrigerants– America's newest, top-quality refrigerants now available to you. He stands for the *people* who go with Ucon Refrigerants... people who know and care about your problems... people who make the difference. So, remember Ucon Ike when you think of Ucon Refrigerants – made by Union Carbide Chemicals Company. Ansul Chemical Company is exclusive sales agent.



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UCON Refrigerants—
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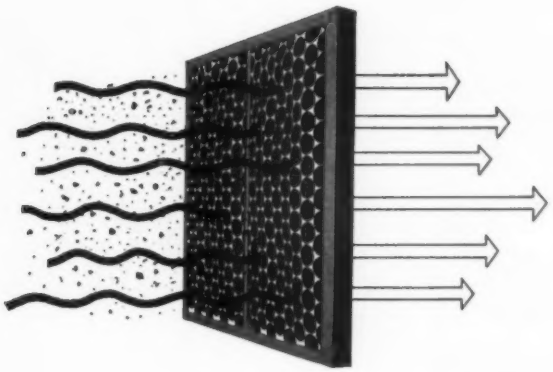
New AAF "throwaway" carbon filter traps odors and dirt...



...permits recirculation of freshened air

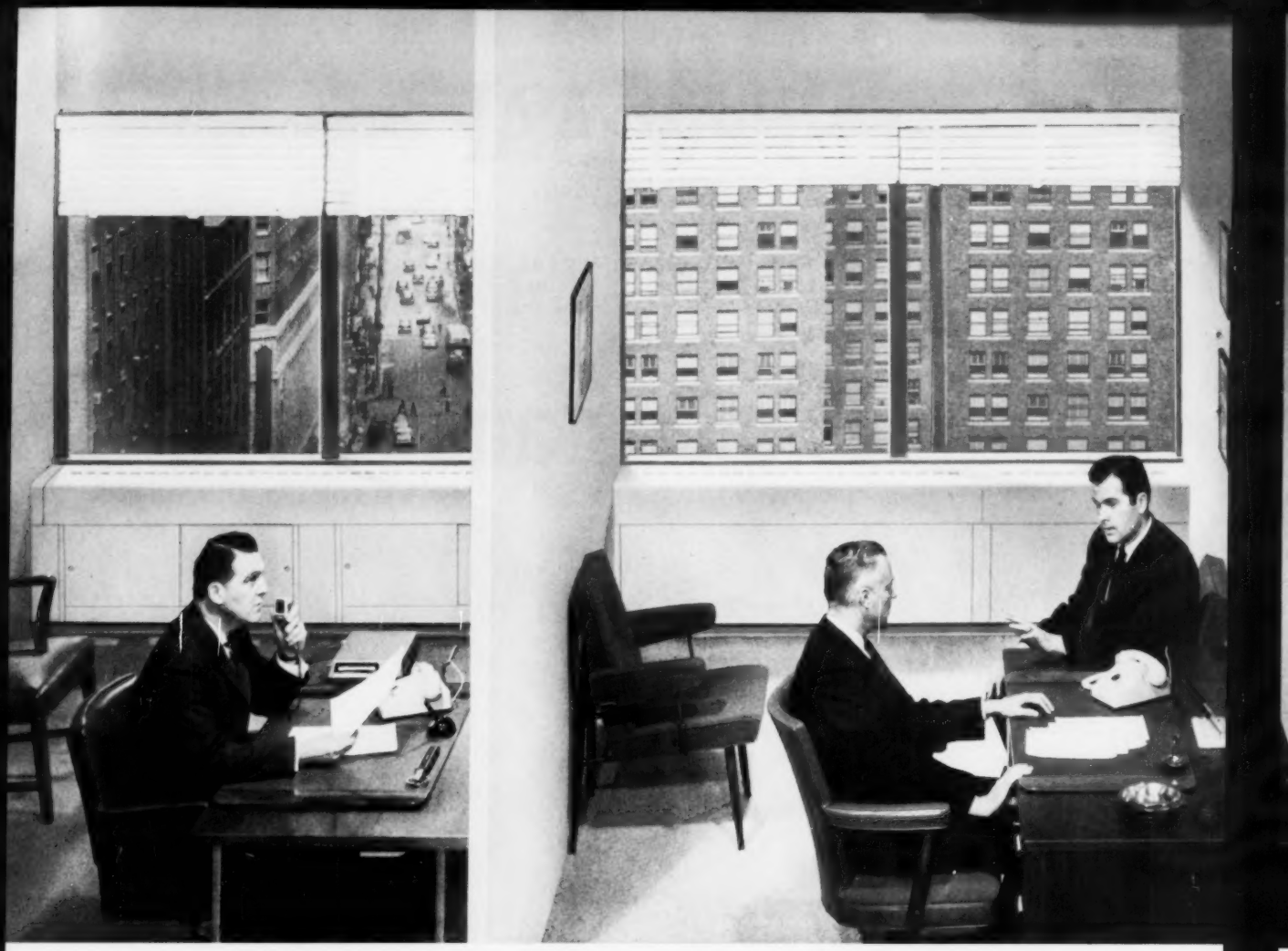
Now you can re-circulate *pure, clean air* – without the forbidding cost of most odor filters – with the new AAF activated carbon filter! Here's how you do it:

- Install the AAF carbon filter in your recirculating equipment. First cost is very low, installation is simplicity itself. There is no maintenance.
- When it's time to replace the filter (after two months for the average application), just lift it out and *throw it away!* Then, replace it with another low-cost, high-efficiency AAF carbon filter. Gone are the trouble and expense of shipping expensive, out-of-service odor removers back to the factory for washing and reactivation.

The AAF activated carbon filter combines high odor removal and retention with high air-cleaning efficiency and low resistance to air flow. *All entering air passes through carbon media.* Comes in four standard sizes to fit two-inch frames. Suitable for both flat and V-bank installation. Filter consists of small resilient fibers, each containing an infinite number of carbon granules. Odors and dirt are caught and held as air passes through the uniformly dense pad. Each filter is shipped in a vapor-proof container, for long storage without deterioration.

For complete details on the new AAF activated carbon filter, contact your local AAF representative, or write for Bulletin 220. Address: Mr. Robert Moore, American Air Filter Co., Inc., 373 Central Ave., Louisville, Ky.

AAF American Air Filter
BETTER AIR IS OUR BUSINESS



Here's how one UniTrane unit (center office) air conditions an entire 24-foot bay. Lateral duct extensions in adjoining offices distribute air from this unit. Components go together quickly, easily, with a minimum of on-the-job fitting.

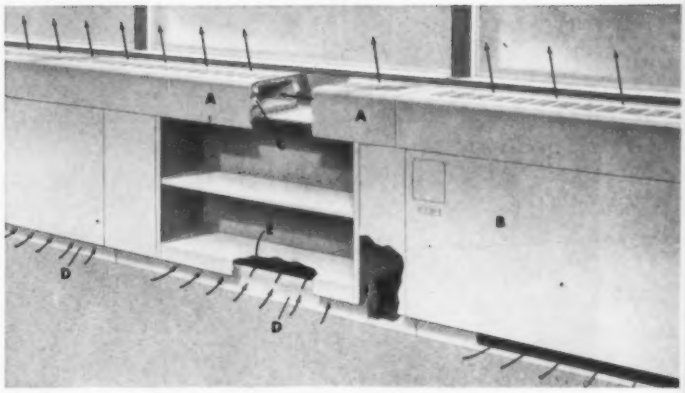
Now! True perimeter with exclusive Trane

Provides a blanket of comfort around building's perimeter—meets changing tenant needs; simplifies installation; cuts piping and control costs

Here is true perimeter air conditioning that meets today's needs for tenant changes—and does it economically. It's the new, exclusive TRANE "Wall-Line" method of air distribution that cuts installation and control costs, makes it easy to meet the varying and changing needs of every building.

Here's how it works:

For example, you install *one* central fan-coil UniTrane Air Conditioner with lateral duct extensions in a twenty-foot bay, instead of three individually controlled units. The extensions distribute conditioned air from the UniTrane unit (cool in summer, warm in winter) all along the outside wall of the bay. And by linking additional fan-coil UniTrane units with winged extensions in adjacent bays or offices, a blanket of comfort is provided around the entire perimeter of the building. There is more flexibility in altering existing walls and partitions—without altering or moving the air conditioning



Conditioned air under pressure rises from plenum extensions (A) and central unit (B)—along entire outside wall. Plenum extensions are heavily insulated (C) to prevent condensation and to reduce noise to an absolute minimum. Return air is drawn through openings at base (D) along the entire installation . . . passes through return air duct (E) to central unit (B).

Check these exclusive Trane features!

- Complete tenant change flexibility at lowest cost.
- Lower installation cost; fewer controls, less piping.
- Quieter operation; air distribution ducts are Fiberglas insulated.
- Custom appearance, attractive shelving, with standard modular units.
- One source for entire operation.

air conditioning "Wall-Line" system !

equipment! In new buildings, there is greater freedom of design than with conventional air conditioning systems: space requirements and floor plans may be worked out *after* the air conditioning has been installed.

Costs are cut because the new TRANE "Wall-Line" system requires fewer individual air conditioning units; in many cases, *one* unit will suffice where *three* would be required with a conventional system. And there is a corresponding saving in controls, piping and installation costs. On-the-job labor is substantially reduced because components are factory-built, ready to install. And this new, improved system provides space for attractive TRANE shelving below the lateral duct extensions. These shelving units enhance the appearance of any office space.

An entirely new concept in big building air conditioning, this new system is available *only* with UniTrane Air Conditioning. For complete facts and specifications, consult your nearby TRANE Sales Office. Or write TRANE, La Crosse, Wisconsin.

For any air condition, turn to

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MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

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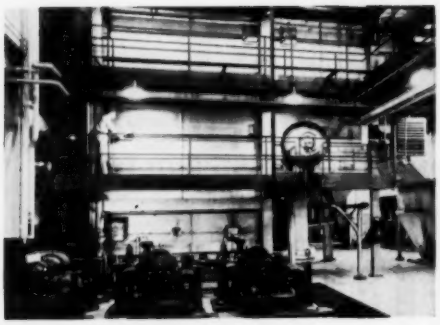


Steam generating plant at Morton, Ill. plant uses two 60,000 lb/hr Wickes boilers, 3 stories high. These are equipped with Hoffman continuous ash-discharge spreader stokers.

Track unloading hopper at York plant. Coal feeds from belt conveyor to bucket conveyor to distributing flight conveyor over storage bunker. Coal handling system by Beaumont Birch.

Ash hopper in Decatur plant. Pneumatic ash removal system by Beaumont Birch Co. connects to vitrified tile ash bin and rotary dustless unloader.

Caterpillar makes tracks for coal

Seven Caterpillar Tractor Co. plants burn coal for low-cost steam generation

When seven plants of a company all burn coal —over 250,000 tons a year—you can be sure there's a *good* reason. At Caterpillar Tractor Co., where steam is used for both process work and heating, coal is burned for low-cost, efficient steam production.

Because of its importance at Caterpillar, steam generation must meet the same standards of efficiency and dependability set up for all phases of plant production. As Caterpillar has expanded from one plant to many, therefore, *each* plant has burned coal.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

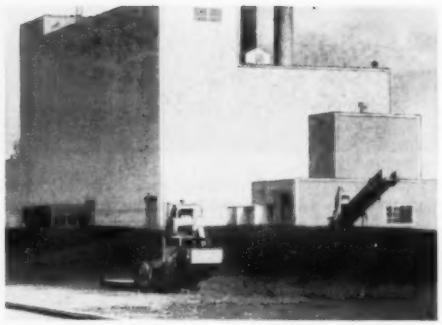
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

BITUMINOUS COAL INSTITUTE

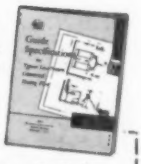
Department HP-06, Southern Building, Washington 5, D. C.

See our listing in *Sweet's*



Exterior view of steam plant at Joliet, Ill. Foreground shows part of outside coal storage area featuring portable car unloader and stacker. Coal is stocked out and reclaimed by Caterpillar bulldozer-equipped crawler tractor.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:



Bituminous Coal Institute, Southern Building, Washington 5, D. C.

Gentlemen: Please send me: HP-06

☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker); ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker); ☐ GS-3 (automatic package boiler for heating and process plants). ☐ Case histories on larger plants.

Name .....

Title .....

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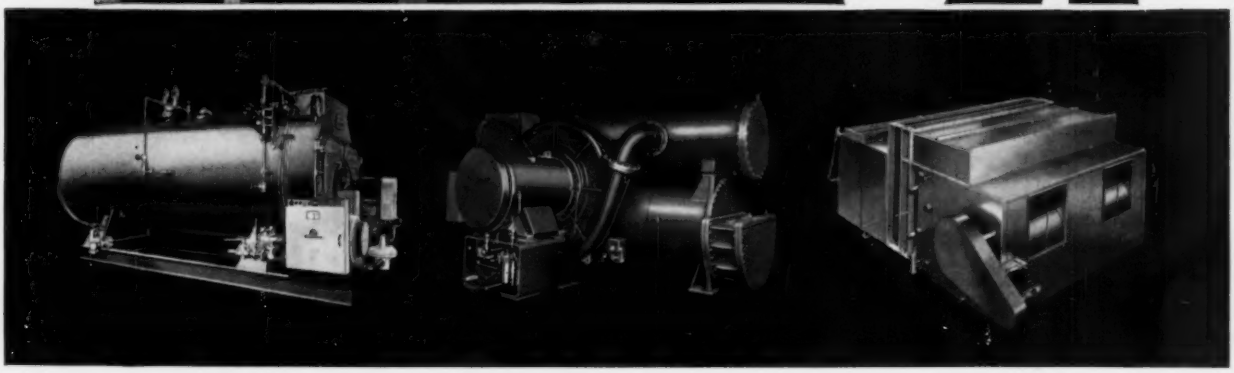
City ..... Zone ..... State .....

Evaluating equipment



Firebox, scotch-type steel boilers and package units for heat, power, steam.

Centrifugal refrigerating machines for central-station air-conditioning systems.

Central-station air-conditioning units for public buildings, industrial plants.

One call for all

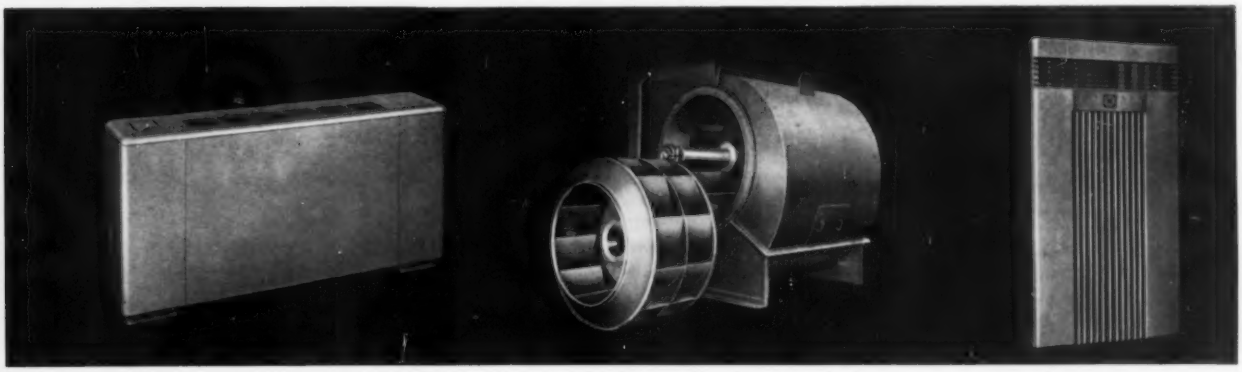
for your air-conditioning job?

Be sure one of the sources you consider is

AMERICAN-Standard Industrial Division

HERE'S WHY: This one organization encompasses the six major fields of air conditioning, heating, ventilating, heat transfer, dust collection, and fluid drives . . . to offer one-source responsibility for quality and performance in equipment that is designed, engineered, and manufactured to work together.

By combining the engineering backgrounds and product lines of three American-Standard* divisions – American Blower, Ross Heat Exchanger, and Kewanee Boiler – the new Industrial Division brings many benefits to *all* business and industry. There are engineer-staffed offices in all principal cities to work with architects, consulting engineers, and contractors with equipment selection and on-the-job problems. Contact the one nearest you. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.



Fancoil units for cooling and heating individual rooms in multi-room structures.

Heavy-duty centrifugal fans for high pressure air conditioning or ventilating needs.

Packaged commercial air conditioners, air- or water-cooled types, 3 to 20 tons.

*AMERICAN-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

BRONZE WALL PLAQUE READS IN PART—

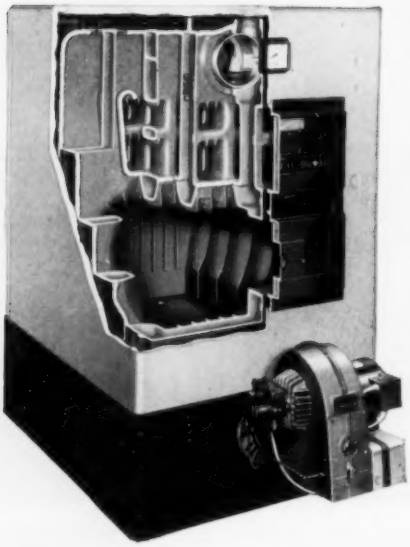
NATIONAL HISTORIC SITE
TOURO SYNAGOGUE of
Jeshuat Israel Congregation
Founded 1658

This oldest synagogue building in the United States was designed by Peter Harrison. Ground was broken August 1, 1759. It was dedicated on December 2, 1763. Here, in 1781-84, the Rhode Island General Assembly met and during Washington's visit to Newport in 1781, a town meeting was held here. The State Supreme Court held sessions here at that period.

The building was re-opened for religious services on August 2, 1850.

NATIONAL PARK SERVICE
U. S. Department of Interior

OLDEST SYNAGOGUE IN AMERICA SELECTS MODERN WEIL-McLAIN BOILER IN RESTORATION PROGRAM



Capacities:
Hot Water, 339,100—793,700 BTU/hr.
Steam, 1415—3305 sq. ft.

Touro Synagogue, in Newport, Rhode Island, is listed as a national historical site. Erected in 1763, it is currently undergoing an extensive restoration program.

A Weil-McLain No. 82 Oil-fired Boiler with a net I=B=R rating of 1580 sq. ft. of steam was selected to replace the old boiler—a selection dictated by the many advantages of this modern *cast iron* boiler.

In the No. 82 Boiler, the exclusive Weil-McLain design of those parts which contribute to efficient combustion of fuel and absorption of heat is an assurance of economical operation. For units burning seven or more gallons per hour, Weil-McLain provides an electronic primary safety control to prove the flame. Easy assembly with short draw-rods and new asbestos rope seal reduces erection costs.

A special feature of the No. 82 is the provision made for single or double domestic water heaters. Dual heaters offer a choice of three advantages: (1) increased volume of hot water, (2) hot water at two different temperatures, (3) one heater to be used for snow melting.

Send for bulletin C-270. For other Weil-McLain Gas and Oil boilers see Engineers' Product File or Sweet's Architectural File.

Architect: Gerald R. Watjand, New York, N. Y.
Consulting Engineers: Hankins and Anderson, Richmond, Va.
Heating Contractors: H. W McPherson & Sons, Newport, Rhode Island
Distributor: Corcoran Supply Co., Fall River, Massachusetts

WEIL-McLAIN

NO. 82 OIL-FIRED BOILER AND OIL HEATING UNIT

WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. AA-69

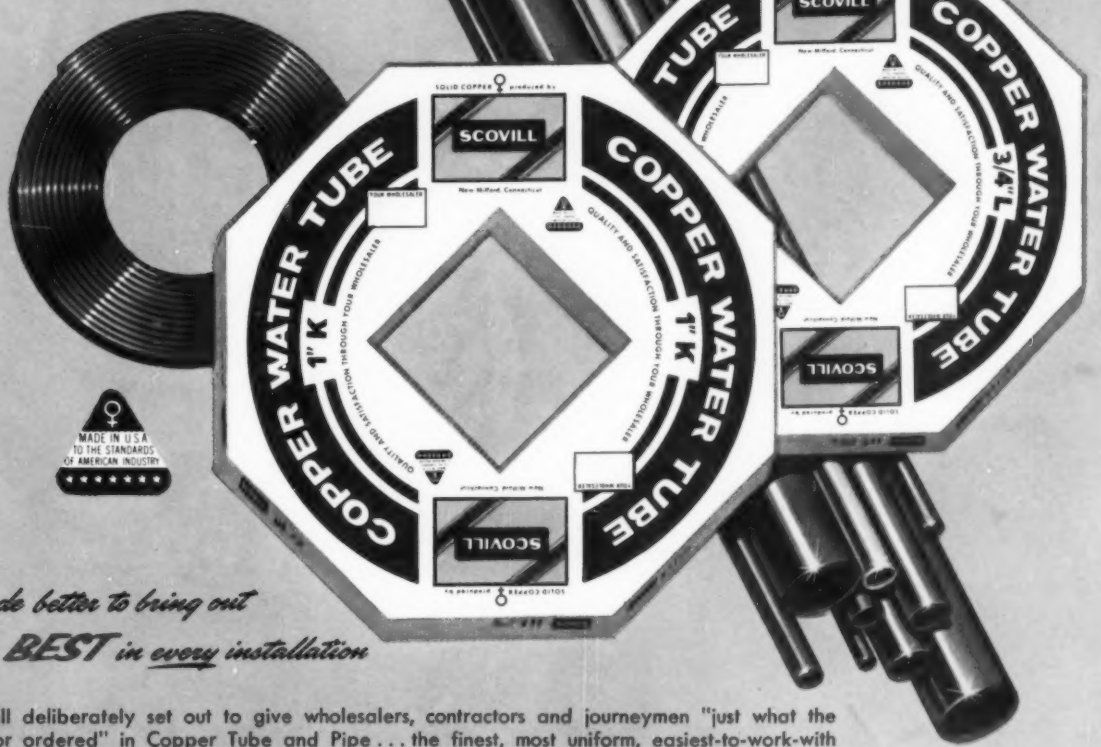
SCOVILL

a **new** standard of **quality** and **service**

under an old and respected name ®

COPPER WATER TUBE K-L-M
COPPER DRAINAGE TUBE (DWV)
COPPER THREADLESS PIPE (TP)
COPPER PIPE
RED BRASS PIPE
COPPER REFRIGERATION TUBE

COPPER WATER TUBE



made better to bring out the ***BEST*** *in every installation*

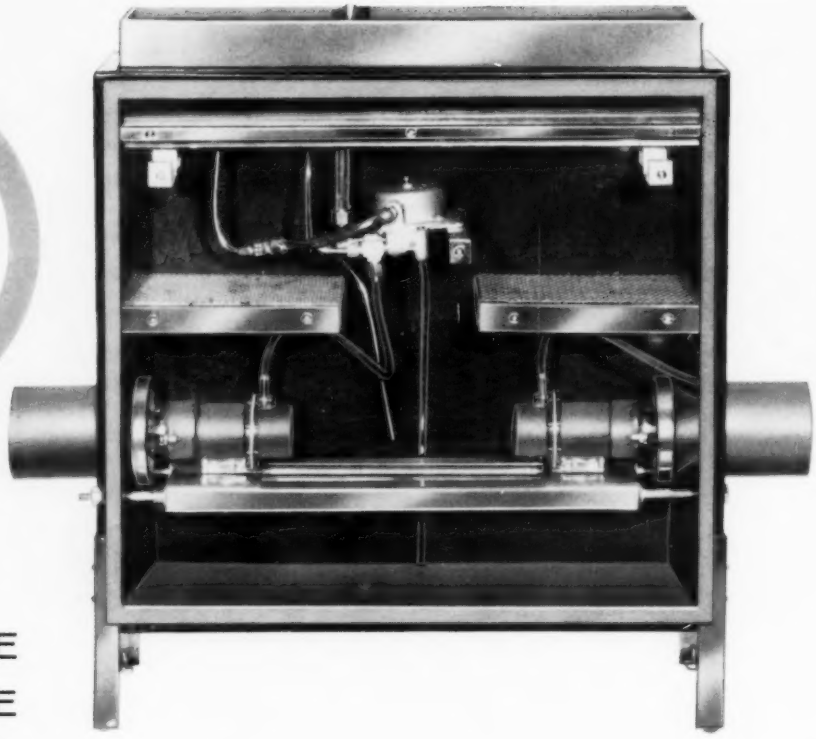
Scovill deliberately set out to give wholesalers, contractors and journeymen "just what the doctor ordered" in Copper Tube and Pipe . . . the finest, most uniform, easiest-to-work-with materials that fine U.S. craftsmanship can produce. Uniquely packaged, identified and delivered on the job just the way you want them! Scovill built ALL-NEW multi-million dollar tube mills, the most advanced in the industry, for this one purpose . . . with nationwide Scovill sales and service . . . yours to command. Place an order today . . . you'll become our lifelong customer tomorrow.

SCOVILL MANUFACTURING COMPANY • COPPER TUBE MILL PRODUCTS, WATERBURY, CONN.

NEW

CON-VOL EQUIPPED HIGH VELOCITY UNITS

CONSTANT VOLUME UNDER ALL CONDITIONS



EXCLUSIVE FEATURE ASSURES PRECISION CONTROL OF AIR VOLUME AND TEMPERATURE

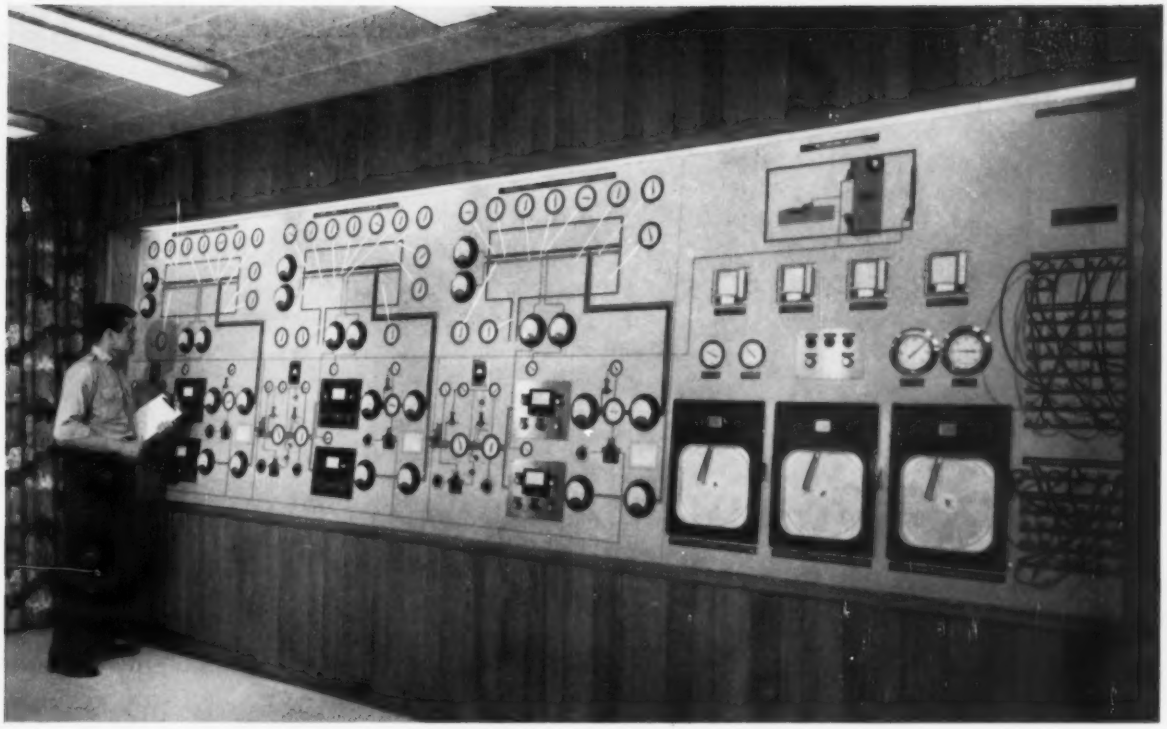
The new Thermotank Con-Vol Unit delivers constant air volume over a wide range of varying inlet pressures. Instant response and positive valve closure are obtained due to the complete absence of linkage or complicated operating mechanism. Both the hot and the cold valves are regulated by the flow controller as conditions demand. An access door permits inspection of all moving parts and easy removal of valves and controls. For more information on Con-Vol equipped units ask your Thermotank-Agitair representative or write direct to Air Devices Inc.

THERMOTANK AGITAIR

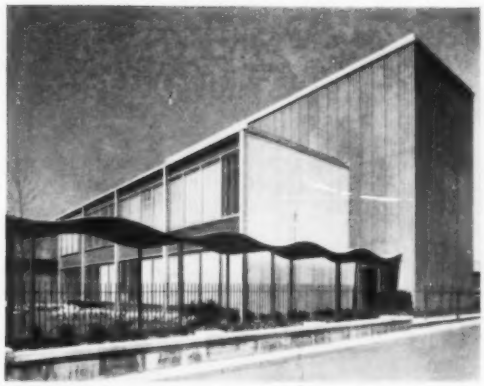
high velocity units • punkah louvers
air diffusers • filters • exhausters
registers and grilles

Sold exclusively by representatives for:

AIR DEVICES INC. • 185 MADISON AVENUE, NEW YORK 16, N. Y.



Pneumatic Control Center Serves Dual Purpose in New H. H. Robertson Co. Building



H. H. Robertson Co., Ambridge, Pa. Oscar F. Wiggins, architect, New York; Wm. A. Rose Associates, mechanical engineers, New York; Martin W. Wise, general contractor, Sewickley, Pa.; McCarl's Plumbing & Heating Co., Beaver Falls, Pa.

Top feature of H. H. Robertson Co.'s new office building is Robertson's own new dual duct air conditioning system, for which it developed the Aerator Mixing Unit and Q-Air Floors that carry hot and cold air to the units.

Shown above is the Johnson Pneumatic Control Center from which the system is supervised and controlled. Operational features of this specially designed panel include *continuous* indication and remote adjustment of fan speeds, temperatures and pressures; graphic representations of the system and its controls; optional recording of key temperatures and pressures; and start-stop switches for all equipment.

Although a comprehensive control panel such as this is not required for the normal operation of a Robertson Q-Air Floor System, it was installed in this case to obtain essential performance data for the guidance of Robertson research engineers. And, as nothing else could, it gives a clear, dramatic demonstration of the Robertson system to engineers, architects and other visitors.

Wherever quality is the key consideration, as it obviously is here, the chances are you will find a pneumatic control system by Johnson. A nearby Johnson engineer is ready to help you give your clients the very best. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

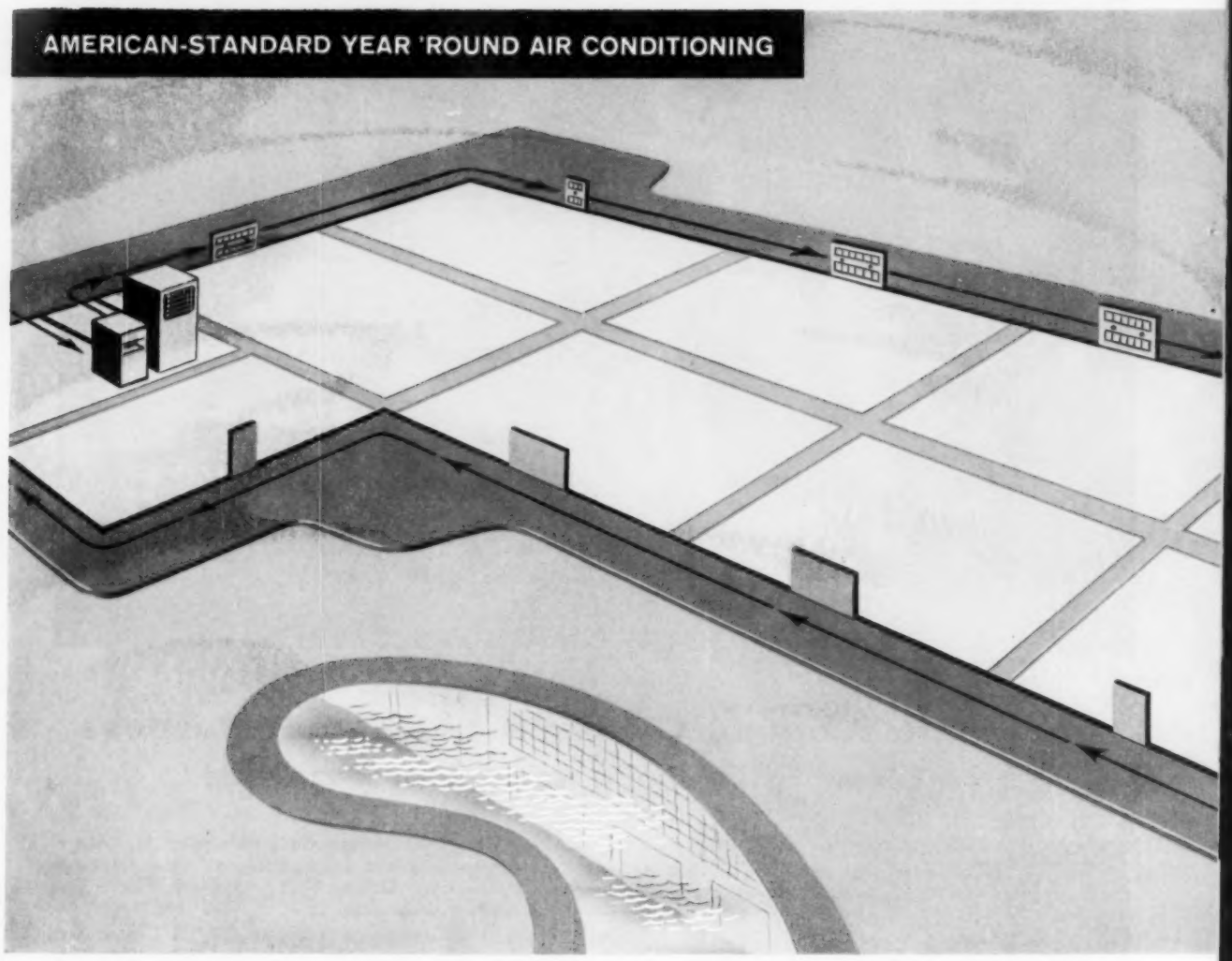
JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

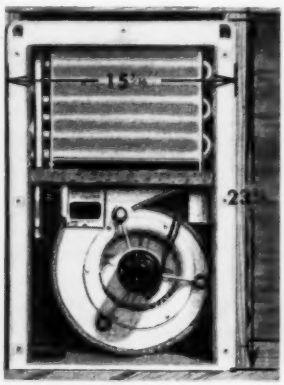
TEMPERATURE & AIR-CONDITIONING CONTROL SYSTEMS FOR COMMERCIAL, INDUSTRIAL & PUBLIC BUILDINGS—AND SHIPS

AMERICAN-STANDARD YEAR 'ROUND AIR CONDITIONING



Remotaire system provides clean, quiet, dependable winter heating and summer cooling distributed evenly and automatically. Sealed piping does not transmit noise, dirt, bacteria or odors from one room to another. Options include adjoining room assembly to condition two small rooms with one unit . . . and intake to introduce fresh air through the unit.

Quiet operation assured by heavy insulation, specially designed and mounted fan motor. Trim shield allows panel to snap off without damaging paint or plaster. UL Re-examination Service Marker.



Single-room unit (150 cfm) fits in one stud space in the wall; double unit (300 cfm, shown at left) fits in two spaces.

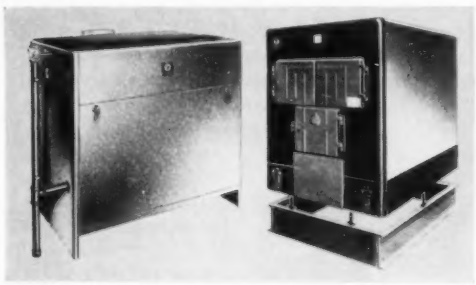
Rheostat, with knob on panel, regulates air volume from 50 to 100%, provides manual shut-off. Motor and control leads are pre-wired to junction box for fast installation.

SAVE SPACE

and cut cost when heating and cooling commercial buildings with Type 10 Remotaire

When you're designing year 'round air conditioning for motels, hotels, commercial buildings and even homes, save space—cut costs with compact, versatile American-Standard Type 10 Remotaire.

Save space with this central hydronic system. It uses a compact boiler-chiller team and small-diameter copper tubing to deliver hot water to room units for heating and chilled water for cooling. Slim room units extend only $2\frac{5}{8}''$ into the room when recessed. Installed free-standing, they are just $6\frac{3}{4}''$ deep. No need for ducts.



Choose from a wide range of American-Standard boilers, both gas- and oil-fired, for your source of hot water. Noted for maximum efficiency in minimum space. Made of corrosion-resistant cast iron sections.

Save cost with a single piping system used for both hot and chilled water. Flexible tubing can be snaked to any location. You can install either heating or cooling only, with provision for adding the other at any time.

Individual-room control allows the occupant in each room to control the amount of heating or cooling he desires.

For more information see your American-Standard representative, or write to AMERICAN-STANDARD, PLUMBING AND HEATING DIVISION, 40 West 40th Street, New York 18, New York.

American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation

AMERICAN-Standard PRODUCTS

AMERICAN-Standard

PLUMBING AND HEATING DIVISION

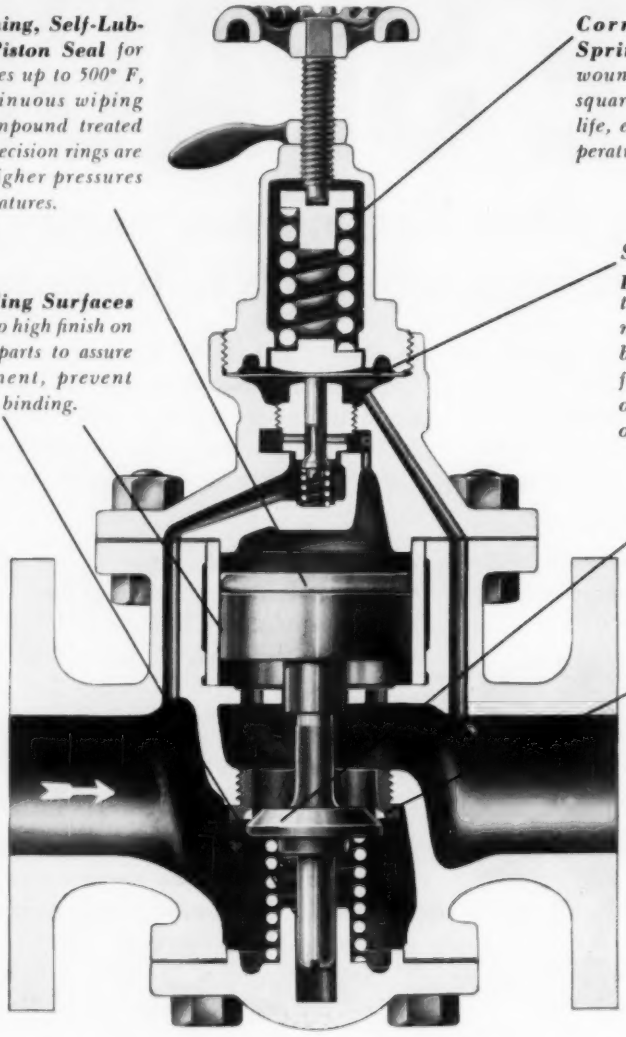
HERE'S WHY YOU GET EXTRA VALUE COMPLETE LINE OF

Self-Cleaning, Self-Lubricating Piston Seal *for temperatures up to 500° F, gives continuous wiping action. Compound treated cast iron precision rings are used for higher pressures and temperatures.*

Corrosion-Resistant Springs *are accurately wound with ends ground square. Maximum spring life, even under high temperature conditions.*

Stainless Steel Diaphragm *responds instantly to any flow change—eliminates stuffing boxes and bellows seals. Diaphragm's full travel is less than its own thickness, can't be over-stressed.*

Long Guiding Surfaces *are ground to high finish on all moving parts to assure true alignment, prevent cocking and binding.*



Single Seated Construction *assures positive dead end shut off.*

Stellited Seating Surface *combined with a hardened stainless main valve provides ultimate in erosion resistance.*

Interchangeable parts *May be replaced without taking valve body off the line, and, even more important, without machining.*

Cutaway of Leslie internal pilot, piston operated reducing valve class LY, shows typical Leslie quality construction features. Throughout the Leslie line, features like these and others presented on the next page are your assurance of lower operating costs and long life performance. They are based on over 50 years of leadership in designing and manufacturing quality regulators.

Internal pilot piston operated reducing valves are available for steam services, up to 2500 lbs., ASA, reduced pressure ranges to 1400 psi. Sizes ½ to 6". Cast iron, bronze, steel or alloy steel construction.

LC-9

IN LESLIE'S REDUCING VALVES AND REGULATORS

LESLIE SMALL FLOW REDUCING VALVES

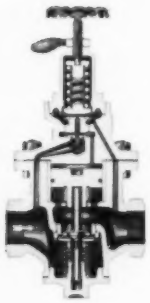
Leslie small flow reducing valves are used in pilot plant operations, plastic molding presses, laboratory units, gland sealing, steam sterilization and atomizer units and wherever control of small flows of steam, air, gas or non-corrosive liquids are a problem.

These ½" valves feature simple, direct operated design with screwed or bolted adjusting spring assembly for easy access to the internal parts. No stuffing boxes or fussy seals.

PRESSURE-TEMPERATURE RANGES

BODY MATERIALS AND CONSTRUCTION	CLASS	MAX. INLET PRESSURE PSI		MAX. TEMP. °F.	MIN. PRESS. DROP PSI	REDUCED PRESS. RANGE PSI
		STEAM	COLD LIQUID AIR OR GAS			
BRONZE Screwed Bonnet	LCA	–	400	150	10	5-285
	LCB LCC LCD	300	400	550	10	10-285
	LCLA	–	400	150	10	2-35
	LCLB LCLC LCLD	300	400	550	10	2-35
STEEL Thru-bolted Bonnet	LCL(B)S LCL(C)S LCL(D)S	600	1000	750	10	25-600 10-50

LESLIE REDUCING VALVES FOR AIR OR GAS SERVICE



Leslie internal pilot, piston operated reducing valves offer a combination of accurate regulation and low maintenance service, and are used for accurate control of air or gas with inlet pressures up to 400 psi at 150° F.

Accuracy of regulation is comparable to instrument control with full flow for equivalent pipe size. Valves feature 99% accuracy of regulation at rated capacity.

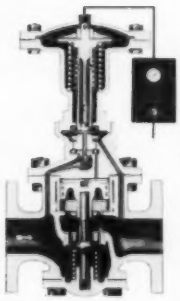
Positive, bubble tight shut-off is provided by resilient, single seated valve disc. Fully guided main valve, stainless steel diaphragm and non-corroding internal springs assure long, trouble-free operation.

PRESSURE RANGES AND CONSTRUCTION

CLASS	SIZE (Inches)	MAXIMUM INLET PRESSURE & TEMP.	REDUCED PRESSURE RANGE PSI		BODY MAT'L	END CONNECTIONS
			MIN.	MAX.		
LA-S LAE-S	½-4	25-400 psi 150° F max.	5*	285	Bronze	½-2" 300 lb. screwed ½-4", 150 & 300 lb. MSS flanged
LAK LAEK		25-400 psi 150° F			Cast Iron	½-2" 250 lb. screwed 1½-3" 250 lb. ASA flanged
		25-175 psi 150° F max.				1½-4" 125 lb. ASA flanged

*5% of inlet pressure over 100 psi

REMOTELY ADJUSTED REDUCING VALVES



Operating characteristics of Leslie remotely adjusted reducing valves are identical to manually adjusted types. The remotely adjusted reducing valve is adjusted to the desired pressure setting by air pressure from an air loading device. The constant loading force on the upper diaphragm opens the pilot valve and is balanced by a constant reduced pressure proportional to the loading force.

The air loading panel eliminates hazardous or inconvenient adjustments and provides fast means of readjusting pressure to meet changing requirements.

REMOTELY ADJUSTED REGULATING VALVES

TYPE	SIZES AVAILABLE (Inches)	BODY MATERIALS AVAILABLE	INLET PRESSURE RANGES (PSI)	MAXIMUM REDUCED PRESS. (PSI)
Small flow, internal pilot actuated, diaphragm operated	¼, ⅜, ½	Bronze	20-300 psi 550° F steam 20-400 psi 150° F air	175
Internal pilot actuated, piston operated	½ - 6	Cast Iron Bronze Cast Steel	25 psi up to 600 psi, 750° F	175
Internal pilot actuated, piston operated for high pressure service	½ - 3	Cast Steel and Alloy Steels	300 psi up to 3000 psi	700

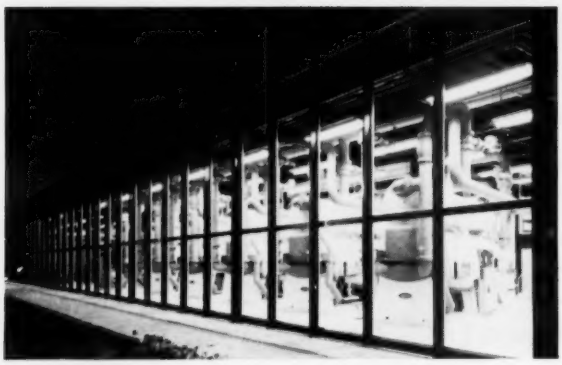
For sizing and capacity data on this Leslie line of valves, contact your Leslie engineer or write for Bulletin 5302B.

TRADE LESLIE MARK

REGULATORS and CONTROLLERS

Leslie Co., 437-B Grant Avenue, Lyndhurst, New Jersey

Over 275 Factory-Trained Engineers At Your Service—Nationwide!



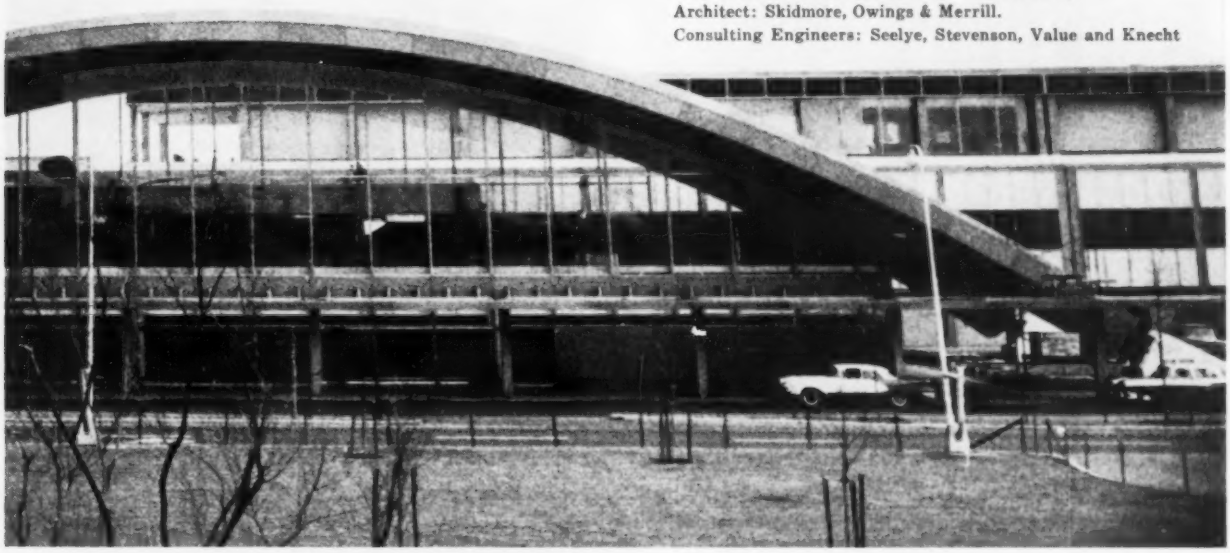
CENTRALIZED SYSTEM
This one central system – nine Carrier Automatic Absorption Refrigerating machines with a total cooling capacity of 6,300 tons – will air-condition all planned buildings in the Terminal City at New York International Airport.

COOL IN SUMMER, HEAT IN WINTER!
These Carrier Automatic Absorption machines, largest units of their type, use heat energy to obtain chilling... operate from the same gas-fired boilers which heat the airport in winter.

THE WORLD'S LARGEST AIRPORT COOLING SYSTEM

uses **GAS**-*operated Carrier Absorption Refrigeration*

Constructed by: The Port of New York Authority
Architect: Skidmore, Owings & Merrill.
Consulting Engineers: Seelye, Stevenson, Value and Knecht



AUTOMATIC, FLEXIBLE, EASY TO MAINTAIN
Gas-operated Carrier machines feature start-stop push button control... adjust from full to zero load and back again *automatically*. With virtually no moving parts, they provide dependable low-cost operation.

New York International Airport gets chilled water for air conditioning its huge complex of Terminal City buildings from Carrier Absorption Refrigeration – one of the most efficient, up-to-date, economical types of systems available today.

Carrier Absorption units use plain water as the refrigerant. No prime mover is required, only low-pressure steam or hot water. Seasonally idle boilers can be put to use on year 'round paying basis . . . and with gas as the boiler fuel, operating costs are cut to a minimum.

This same type of automatic operation can make your boilers pay off all summer, too – with low-cost comfort cooling. For full details, call your local gas company, or write Carrier Corporation, Syracuse 1, New York. *American Gas Association.*

Climate by Chrysler

erases $10,615 a year off the cost of erasers for Venus Pen & Pencil

Venus Pen & Pencil Corp. now produces better erasers—and saves $10,615 a year besides—by using a Chrysler Liquid Chiller to supply cool water for the rolls used in calendering the rubber.

The rolls must be kept from overheating to prevent discoloration or damage to the rubber. Venus Pen & Pencil had been using city water in its Lewisburg, Tenn., rubber plant. Water costs ran nearly a penny per pound of processed rubber. And, since water temperature rose too high in summer, 10% of its production was wasted.

The Chrysler Liquid Chiller solved the production problem by keeping recirculated water at a constant 50° F. Eraser quality improved . . . and $9,000 worth of waste rubber per year was eliminated. Water costs were cut almost 75%—saving $3,550 annually. And maintenance costs on the rolls dropped $500. Net savings of $10,615 in the first year practically paid the entire cost of the Chrysler Liquid Chiller installation.

Where chilled water is required for cooling a process, or cooling for comfort, Chrysler equipment offers many exclusive advantages: Hermetically sealed Radial Compressor, innerfin direct expansion chiller, lower installation and maintenance costs. Get the complete story and technical data from your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corp., Dept. Y-69, Dayton 1, Ohio. In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario.

CHRYSLER AIRTEMP

FIRST WITH THE FINEST IN AIR CONDITIONING

EFFICIENT
VENTILATION

TEAR HERE FOR PERMANENT FILE

COMPARE

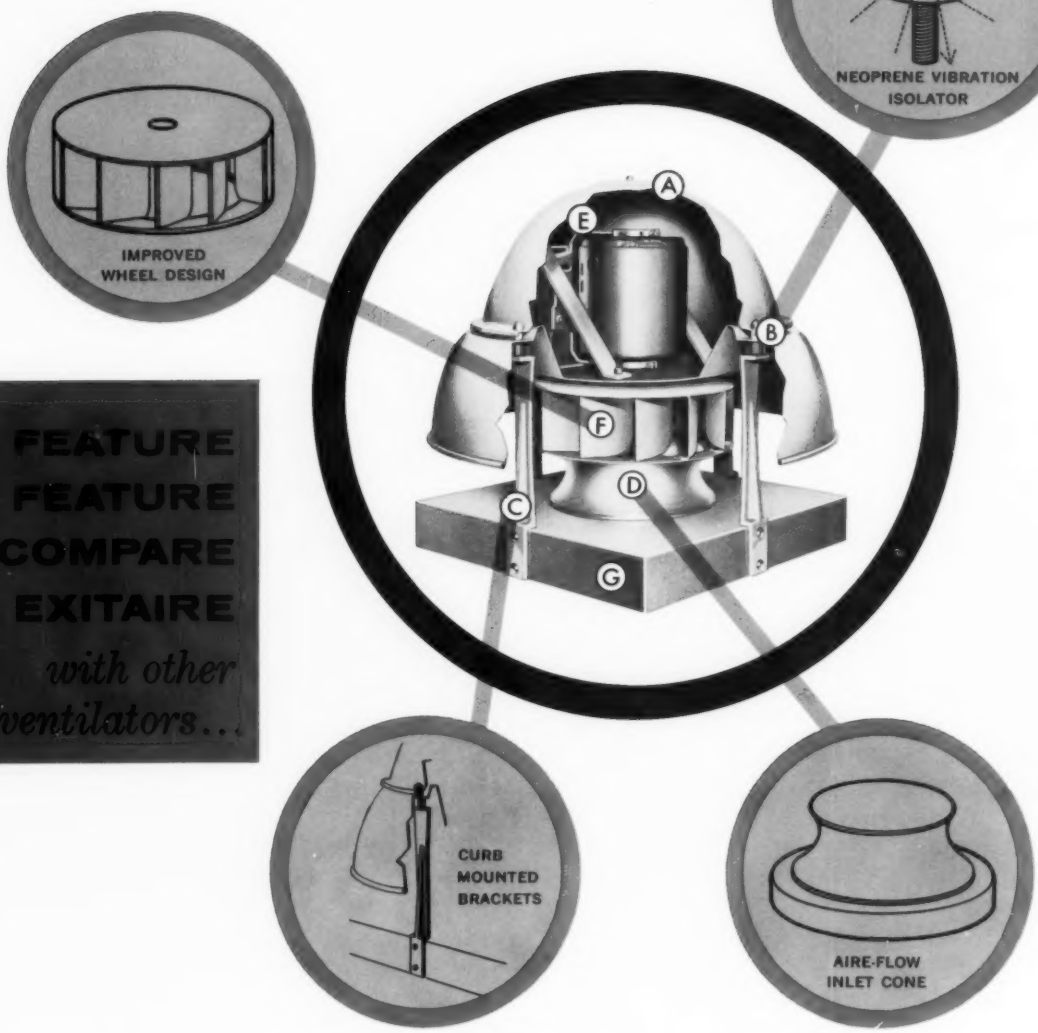
EXITAIRE

ExitAire Exhausters are manufactured exclusively in this modern plant in Pacoima, California.

FOLD OUT THIS PAGE

TEAR HERE FOR PERMANENT FILE

FEATURE BY FEATURE ...COMPARE EXITAIRE *with other ventilators...*



A. LOW SILHOUETTE conforms with modern architecture.

B. SILENT, VIBRATIONLESS OPERATION... Motor compartment is insulated from vibration to the curb by individual Neoprene "sandwich" dampeners which provide multi-directional compensation for all vibration, making operation silent and smooth...eliminates need for rubber curb cap.

C. CURB MOUNTED BRACKETS for extra rigidity. The unit is solidly suspended by 4 sturdy cast-aluminum brackets attached directly to the curb. Compare with units whose vibration mountings are made of dissimilar metal resting directly on spun aluminum housings, subject to electrolysis between the dissimilar metals, **often resulting in deterioration and collapse.**

D. "AIRE-FLOW" INLET CONE similar to centrifugal blower-type for maximum efficiency with air turbulence reduced to a minimum. Allows use of smaller wheel which is quieter in operation.

E. DISCONNECT SWITCH is provided for mounting in motor compartment. Standard on single speed unit 10″ and larger.

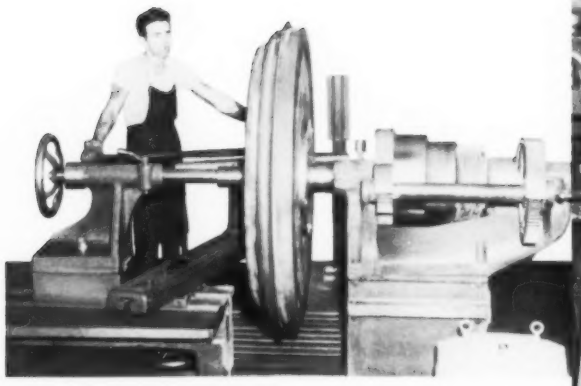
F. NEW WHEEL DESIGN delivers more capacity per HP rating than conventional wheels. Small size is easier to balance.

G. COMPLETE CURB MOUNTING... An integral part of the unit, no extra cost!

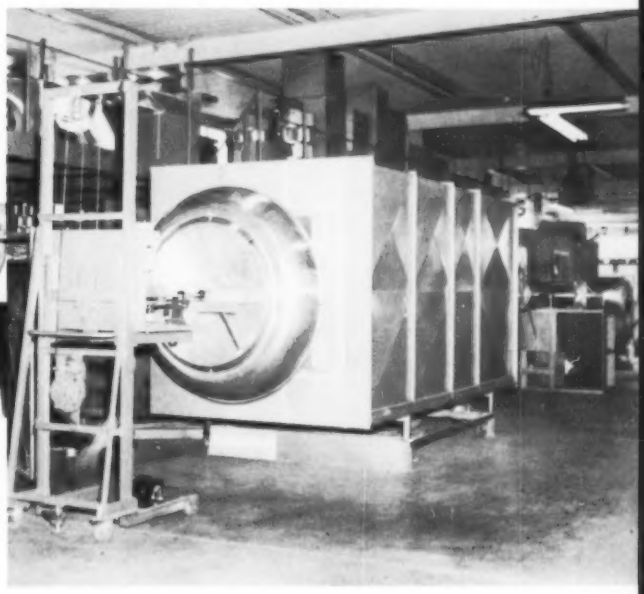
CERTIFIED CAPACITY RATINGS!

Power Exhausters carry the Certified Rating Seal of the Air Moving and Conditioning Association. The A.M.C.A. Certified Ratings of units are obtained through tests made in accordance with A.M.C.A. Standard Test Codes, which apply only to units with 12-inch and larger wheel diameter. Smaller units are tested by the nozzle chamber method.

Power units also carry UL approval—consult Underwriters' Laboratories, Inc. listing.

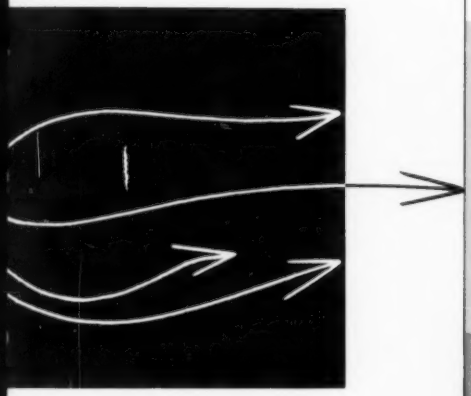


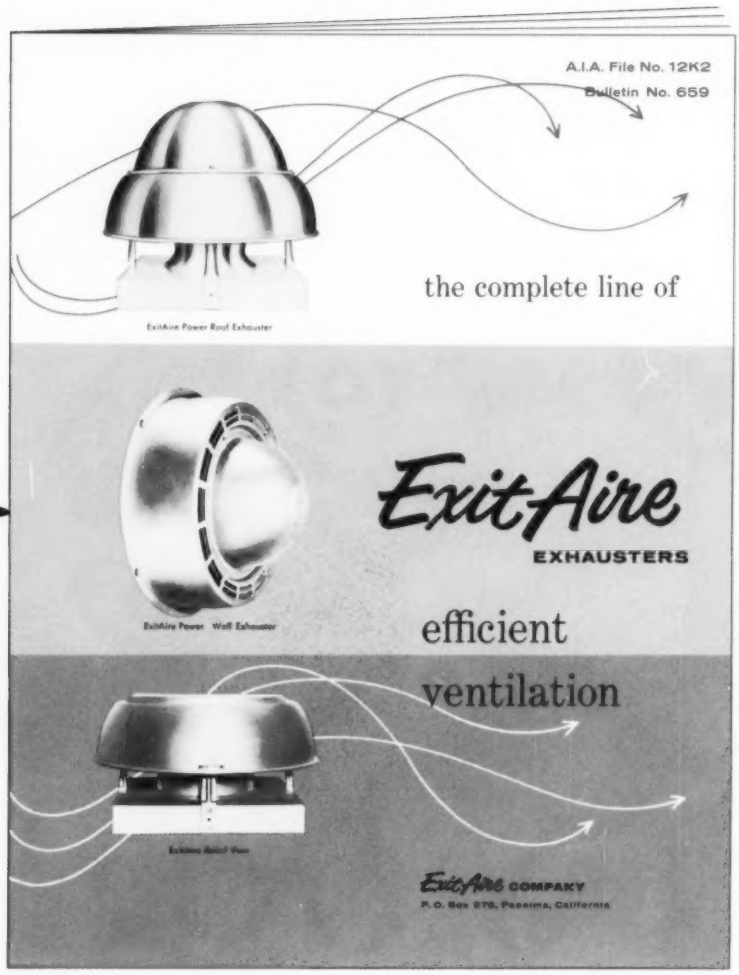
This lathe spins skirt for a 48-inch ExitAire unit.



36-inch ExitAire assembly being tested on standard AMCA test stand in ExitAire Plant. The horsepower is being checked by dynamometer.

YOU CAN BE SURE WHEN YOU SPECIFY *ExitAire*





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EXITAIRE CO., Dept. A
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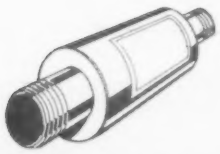
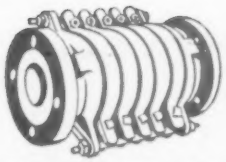
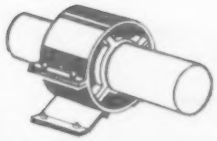


FLEXONICS Model H Expansion Compensator —in sizes to 3", for pressures to 175 p.s.i., absorb 2" total pipe motion at each unit.

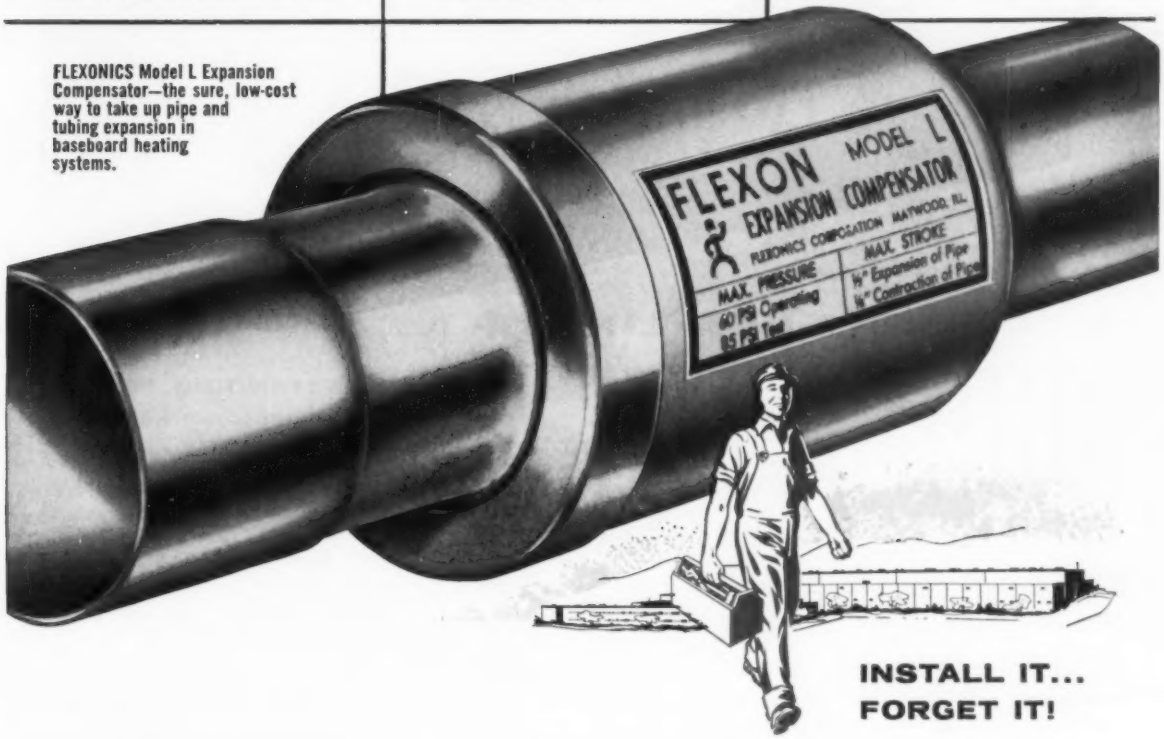


FLEXONICS Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



FLEXONICS Pipe Guides—a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.

FLEXONICS Model L Expansion Compensator—the sure, low-cost way to take up pipe and tubing expansion in baseboard heating systems.



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FORGET IT!

ENGINEERS ACR SS THE COUNTRY ARE SPECIFYING FLEXONICS MODEL L PACKLESS EXPANSION COMPENSATORS

You'll find FLEXONICS Model L Expansion Compensators written into the heating specifications for the finest, most modern buildings across the country. There's no substitute for their completely packless design, their easy installation, and the fact that they *never need maintenance!*

There's no easier or lower-cost way to take care of pipe and tubing expansion and eliminate water hammer noise, especially in baseboard convector installations. Install a FLEXONICS Expansion Compensator in minutes—forget it for the life of the building.

They have been proved in thousands of installations. Why not write them into your next job? Write today for cost data, and the name of your FLEXONICS representative.

Today—write for informative and helpful Catalog

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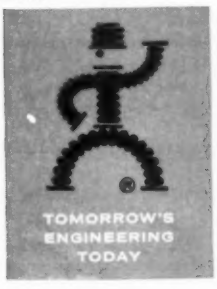

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EXPANSION COMPENSATORS

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Announcing

A COMPLETE NEW LINE OF

SHAFCONAIRE

SUSPENDED *GAS FIRED* FURNACES

priced to give you a competitive advantage in the commercial and industrial heating markets!

Another "*First*" for Shafconaire! A new line of suspended gas-fired furnaces designed *right* built *right* for commercial-industrial use—and *priced right*, too, to give you profitable, volume sales! For these new Shafconaires actually cost less than any other type of gas heating equipment of equal capacity on the market today. What's more, they're covered by all required approvals for immediate installation.

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- **Power Burner**—provides closer control of gases through heat exchanger—gives greater heating efficiency and lower heating costs.
- **Large Capacity**—designed to handle greater volume of warm air at higher velocity—can be easily connected to duct work to provide controlled distribution of heat.
- **Maximum Head Room**—approved for installation two inches from combustible materials, compactly designed to assure greater clearance.
- **Versatility**—quickly, easily adapted in the field for right hand or left hand installation.

AVAILABLE IN 6 BASIC MODELS TO GIVE YOU BROAD MARKET COVERAGE

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In addition to these six basic models, Shafconaire Gas-Fired Furnaces can also be supplied for duct heater applications. All models are furnished complete with power burner, blower, controls and with or without filters as desired.

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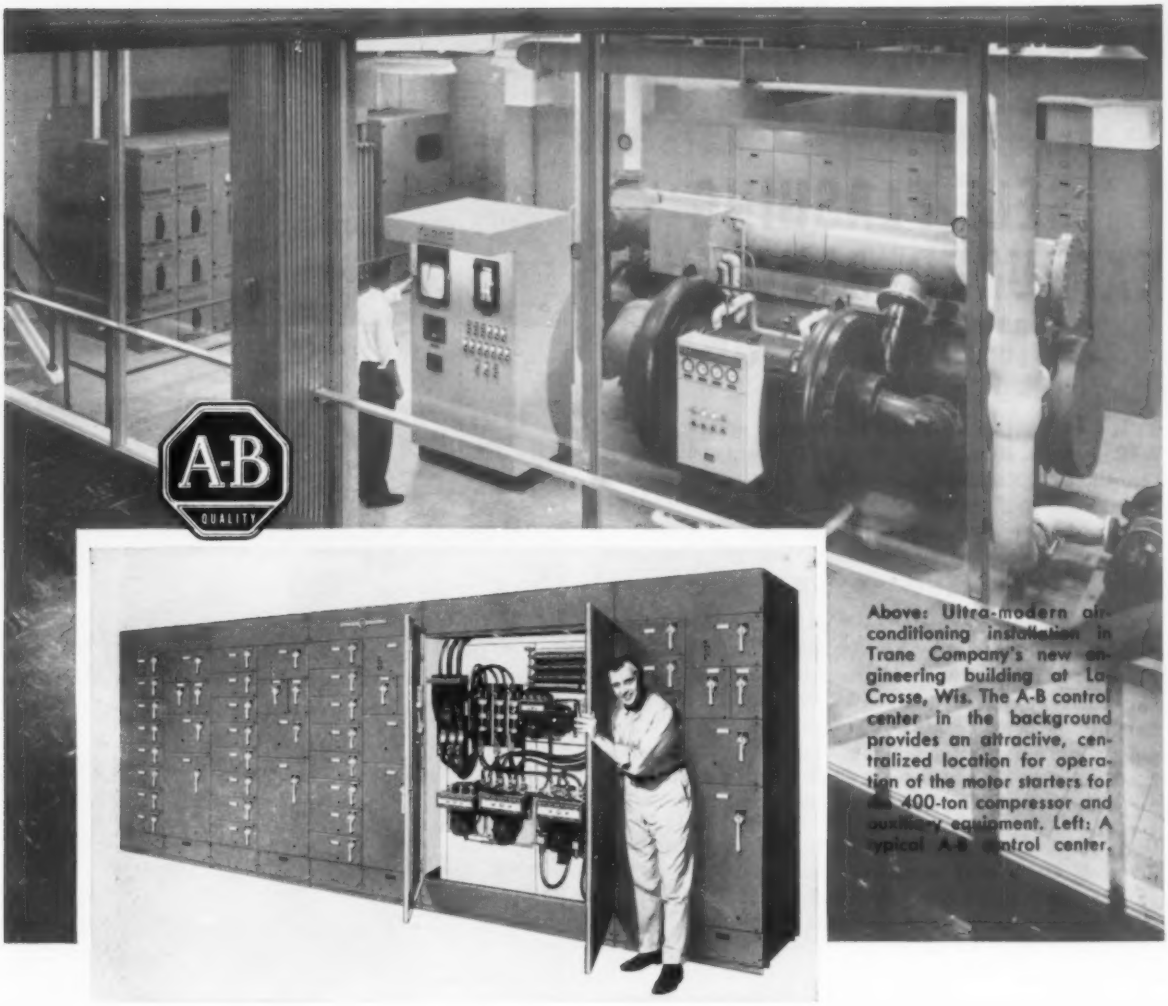

Above: Ultra-modern air-conditioning installation in Trane Company's new engineering building at La Crosse, Wis. The A-B control center in the background provides an attractive, centralized location for operation of the motor starters for the 400-ton compressor and auxiliary equipment. Left: A typical A-B control center.

TRANE—specialist in air conditioning . . . uses

ALLEN-BRADLEY Motor Control

for its new engineering building

Manufacturers of electrically powered equipment are the *first* to realize how important reliable motor controls are to the performance of their installations. And to insure this desired reliability, more and more leading companies are turning to Allen-Bradley—the *quality* motor control.

The simple solenoid design—for which Allen-Bradley starters, contactors, and relays are famous—has only ONE moving part. With virtually *nothing* to go wrong, you are assured millions of trouble free operations. There are no bearings, pivots, or pins to corrode and stick . . . no flexible jumpers to wear and break.

In addition, the double break, silver alloy contacts—a standard feature throughout the Allen-Bradley line—never need service attention. They are always in perfect operating condition . . . and remain so without maintenance until completely worn away. And *all* Allen-Bradley starters are equipped with two reliable and permanently accurate thermal overload relays to protect motors against "burnouts."

Guard against control failures on your equipment the way leading companies do—specify Allen-Bradley *quality* motor control. You *cannot* do better!

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis. • **In Canada: Allen-Bradley Canada Ltd., Galt, Ont.**

Announcing

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SHAFCONAIRE

SUSPENDED *GAS FIRED* FURNACES

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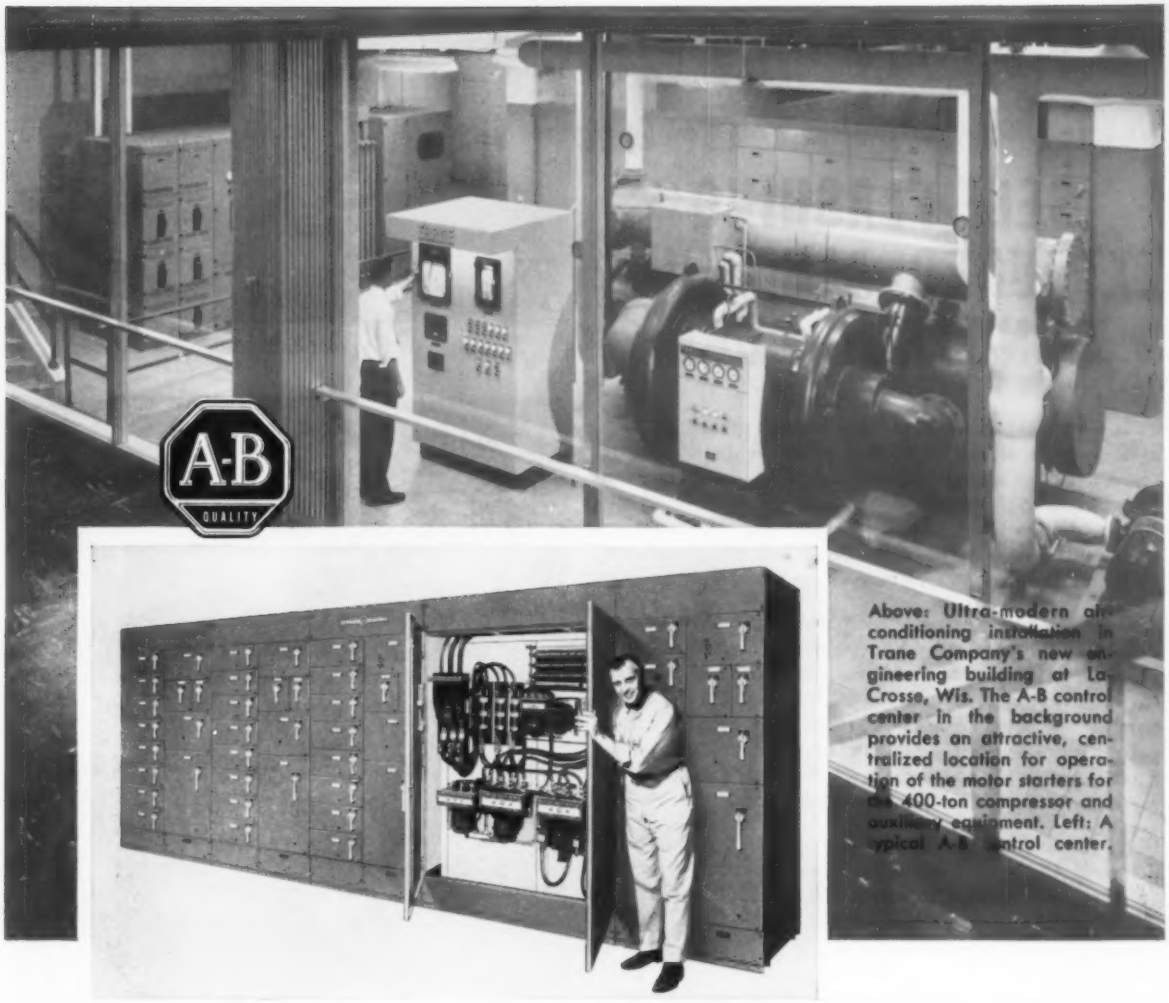

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Six steps to better curbing with Penn Ventilator

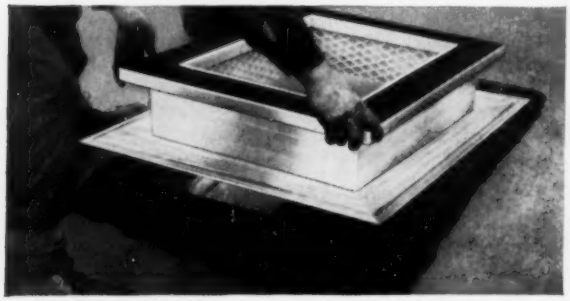
SELF-FLASHING EXTRUDED ALUMINUM SONOTROL CURB

That's all there is to it. It's the biggest advance yet in roofing curbs. Eliminates errors in the field . . . no more coordinating, flashing and waiting. You just place your order when roof opening dimensions are set . . . and the curb is delivered when you need it. Penn Ventilator is the single source of responsibility. You get ventilator, curb and damper . . . and everything fits.

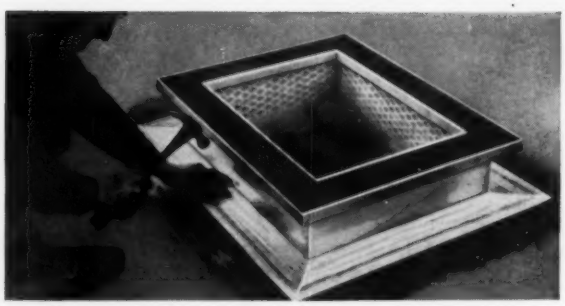
The self-flashing feature keeps units low to the roof and is used and approved by leading roofing material manufacturers. All-aluminum construction of the new Sonotrol Curb reduces roof loading, saves time, makes it easy to handle. "I" beam design adds to its sturdiness. It's nonporous and weathertight, includes an integral neoprene-rubber gasket. Special acoustical insulated lining provides for sound attenuation, and eliminates condensation.

Get complete details on this revolutionary self-flashing Sonotrol Curb that actually costs no more than the "hit-or-miss" method of field construction. Your nearby Penn Ventilator man has a sample section to show you.

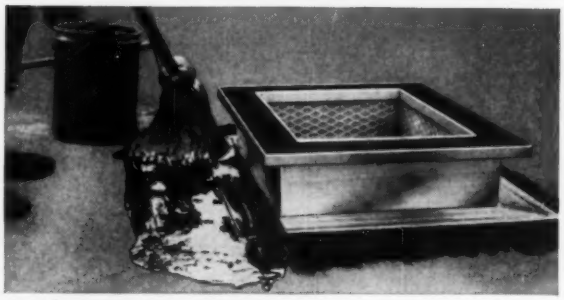
1. Butter 12" wide bed of plastic roofing cement around roof opening.



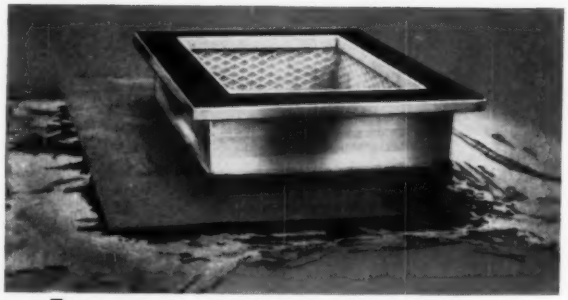
2. Set curb in roofing cement.



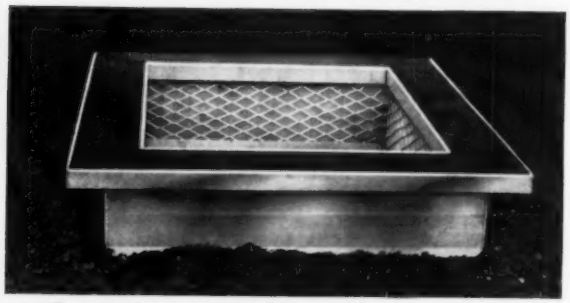
3. Fasten curb to roof deck.



4. Prime for strip flashing.



5. Strip flash and finish roofing around curb.



6. Curb is now ready for ventilator.

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GOODMAN & ALLEGHENY, Philadelphia 40, Pa.
Representatives and Distributors in Principal Cities
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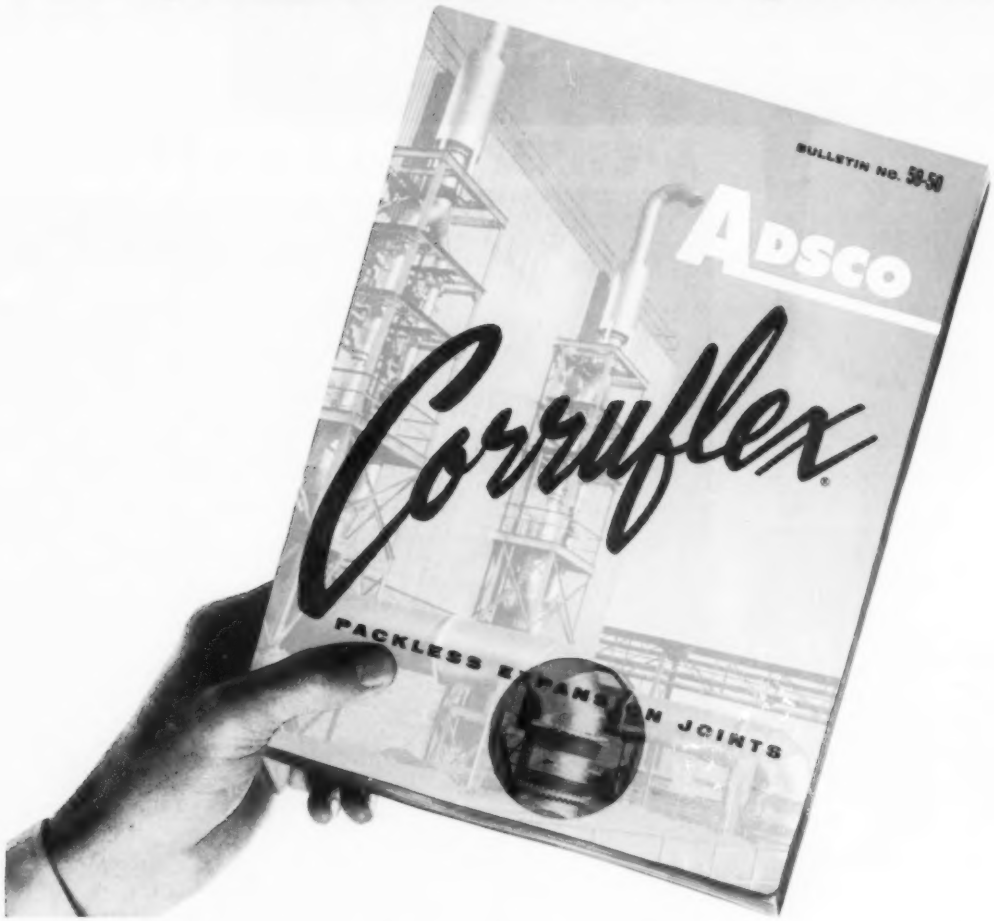
A Leading Manufacturer of Powered and Gravity Roof Exhausters and Accessory Equipment for over 25 years.

A New and Invaluable Reference Work for Design and Specification of Packless Expansion Joints



Every engineer working with piping that requires precise control of movement of any type, will find this new 76 page booklet one of his most valuable working references. ADSCO Corruflex Packless Expansion Joints in a wide range of metals and alloys, for high and low pressures and temperatures, are fully described and illustrated, with complete engineering and installation data and comprehensive tables of forces, movements and dimensions. You can rely on ADSCO . . . world's largest manufacturer of both packless and slip-type expansion joints.

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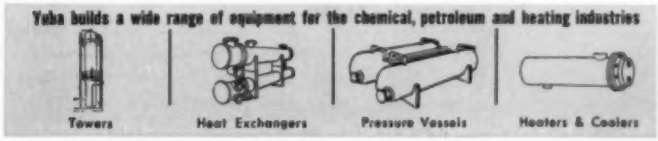
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capacity?...safety?"

Compare these gas capacities

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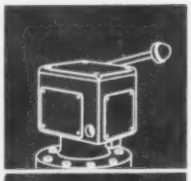
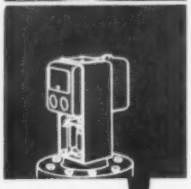
1 SCR	2,000	50	37.8	920
1¼ SCR	2,700	50	51.0	1,370
1½ SCR	4,000	50	75.6	1,840
2 SCR	8,000	25	151.0	3,570
2½ SCR	12,900	15	244.0	4,500
3 SCR	17,000	15	320.0	6,600
4 FLG	27,000	8	510.0	8,900
6 FLG	54,000	5	1020.0	17,800

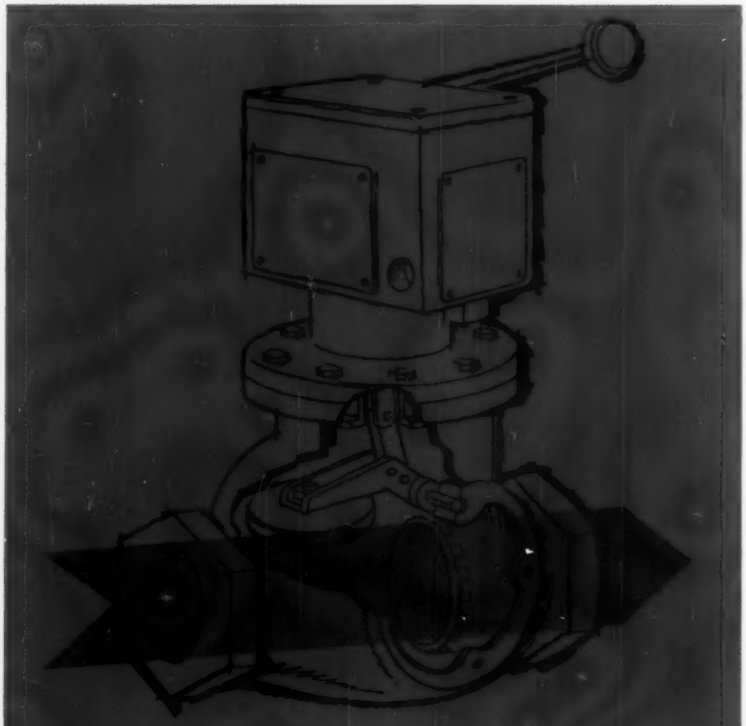
CHOICE OF TWO ACTUATORS:



V-116 MANUAL RESET, with lever action—90° handle travel. Held open electrically, spring closed on power interruption.



H-117 HYDRAMOTOR, electric reset, with either fixed opening speed or adjustable opening speed regulated to design of equipment.



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Straight through flow provides high capacity . . . minimum pressure drop. And you get an unequalled combination of safety characteristics. *Spring-loaded* inner valve closes with pressure for positive safety shut-off. Direct in-line action without complicated linkage. *Rubber-faced* vertical seating won't scratch or score . . . assures *tight shut-off*. *Dual release actuator* assures positive closing. Fixed or adjustable opening speeds for specific duty. Line sizes from 1" to 6" pipe. Costs less than valves that can't measure up in quality, performance or adaptability. Check the capacity table . . . then check the valve out with your nearest General Controls representative."

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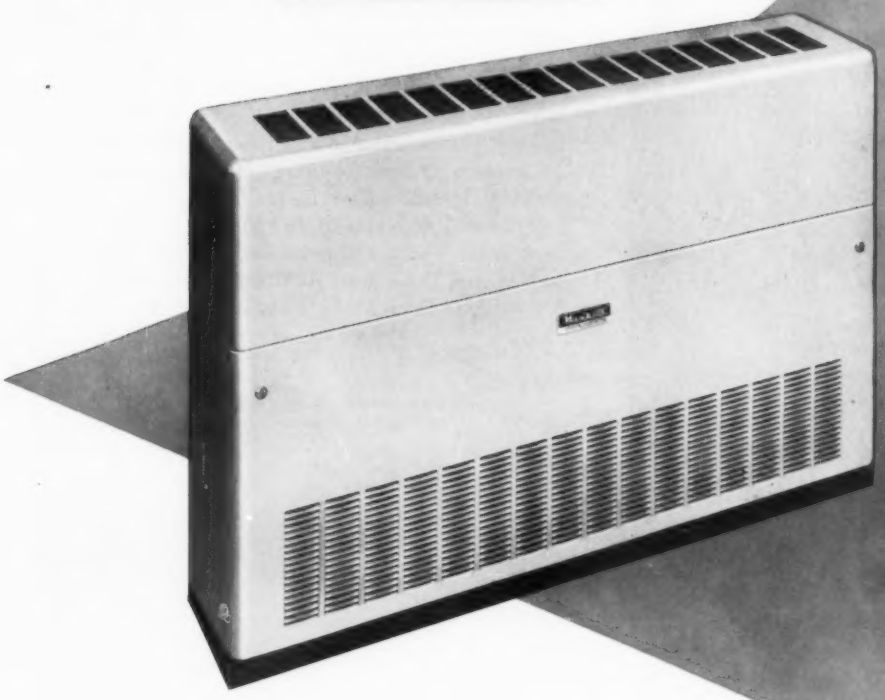

27 STANDARD FLOOR TYPE INSTALLATIONS

plus

32 STANDARD WALL AND CEILING TYPE INSTALLATIONS

equals

59* STANDARD INSTALLATION ARRANGEMENTS

multiplied by

7 STANDARD MODELS

totals

413

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You can fit these compact, quiet, trouble-free units easily and smartly into any plan. They're available in seven standard colors, with baked enamel finish. Get all the facts. Write Nesbitt for publication 403-2.

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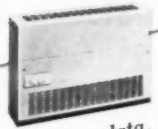

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Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.

27,000 feet of heat...

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For installations such as the Air Force Academy, architects and contractors consistently look to USS National Pipe. As a matter of fact, they've been specifying National for more than 60 years for conventional plumbing and heating systems. It makes sense, too! You know why? Because National Pipe has the qualities to meet the requirements of these applications . . . smooth, uniform bending . . . sound, strong welding . . . and long service life. These qualities have made USS National Pipe the largest selling pipe in the world. For more information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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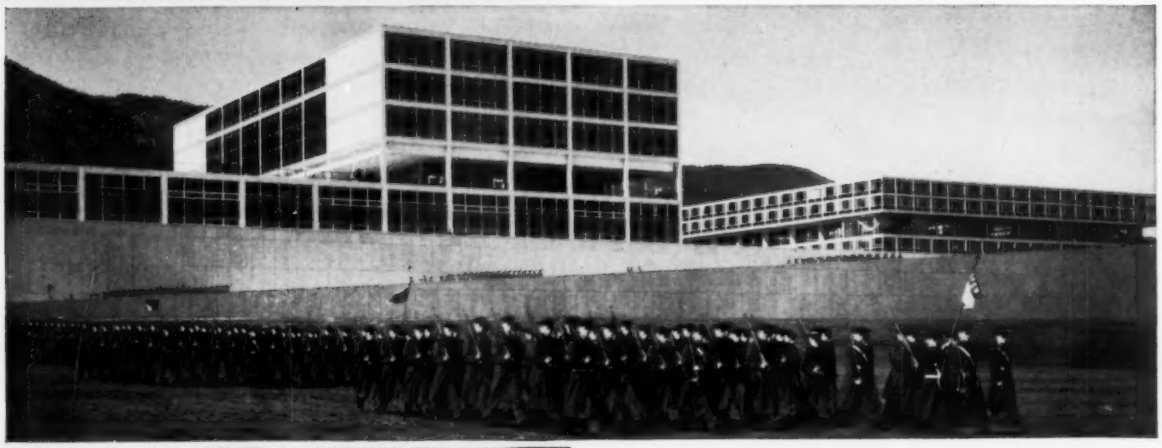

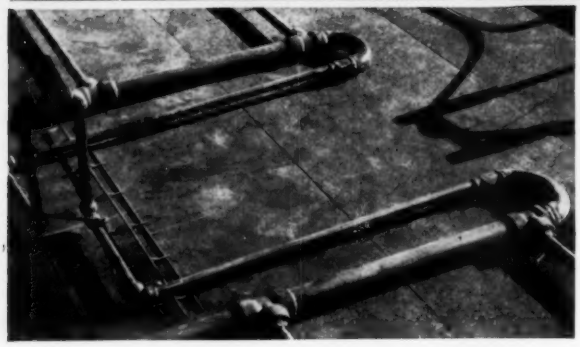

National Tube Division of United States Steel

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. . . are frequently SPECIFIED by leading engineers for important installations

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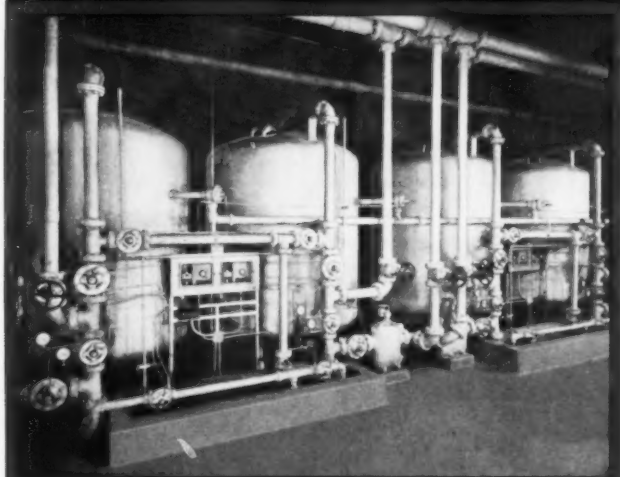

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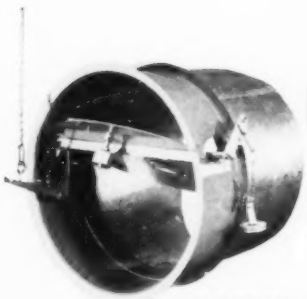

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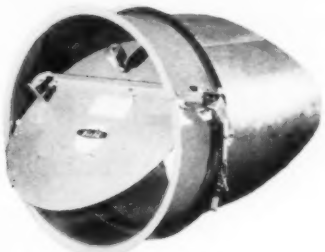

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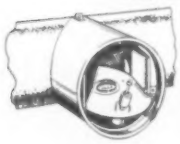

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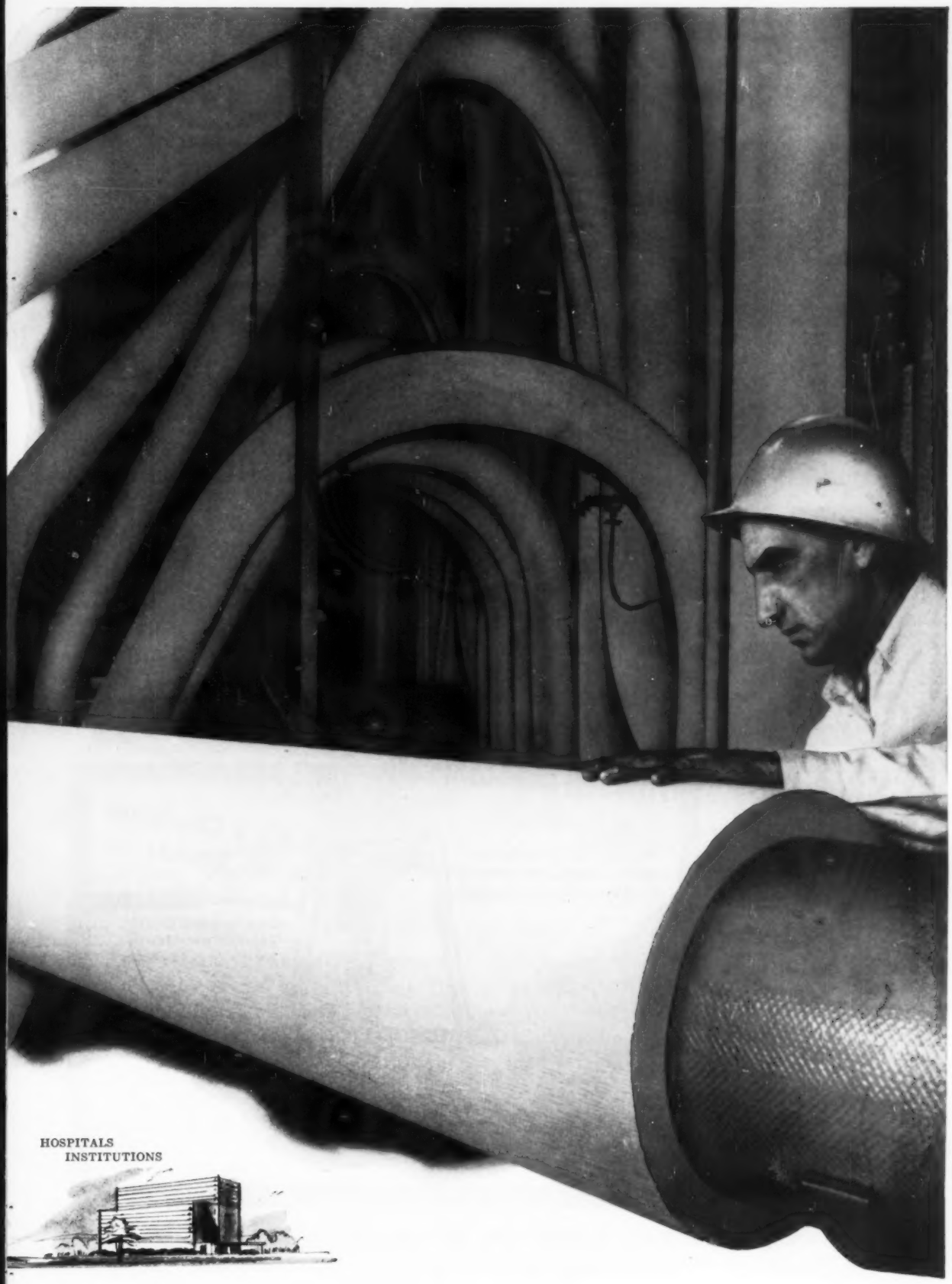
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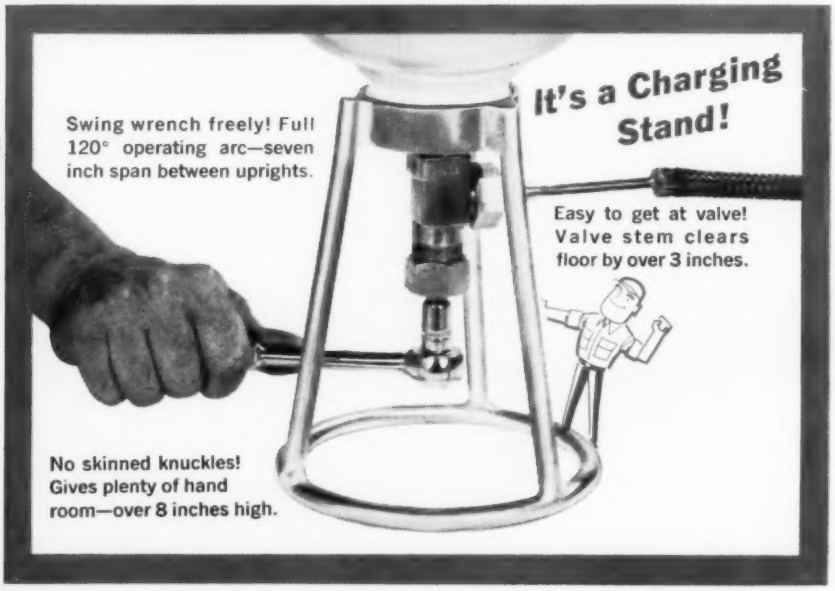
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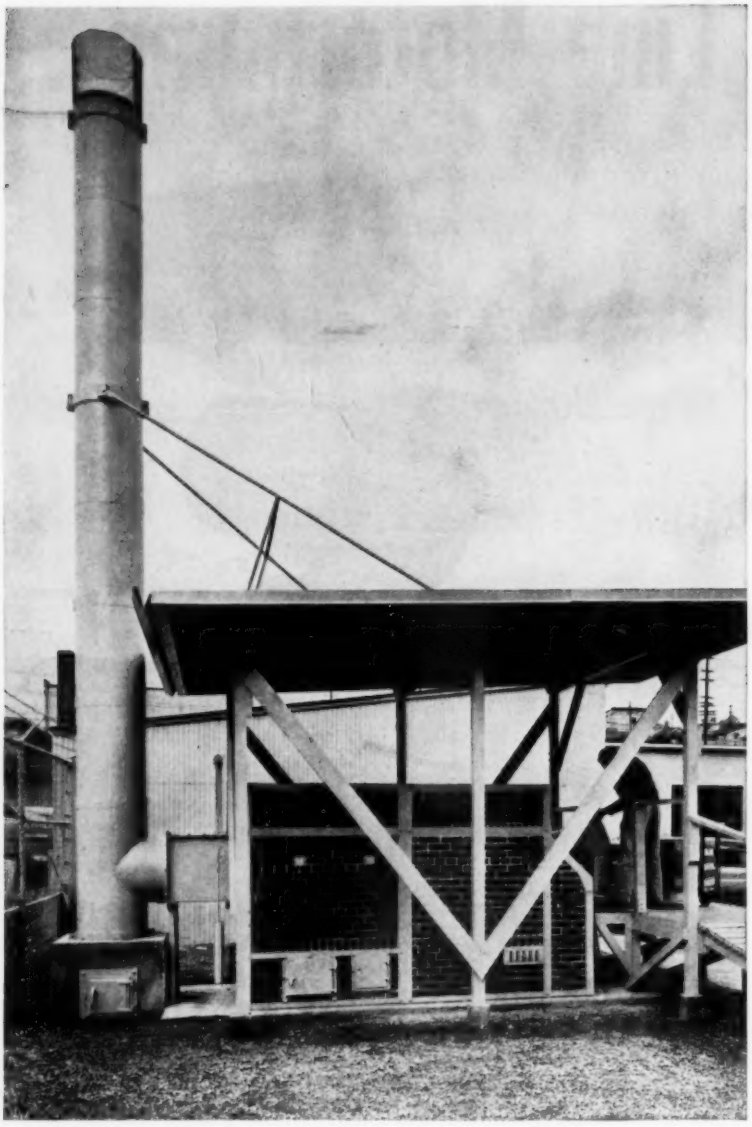

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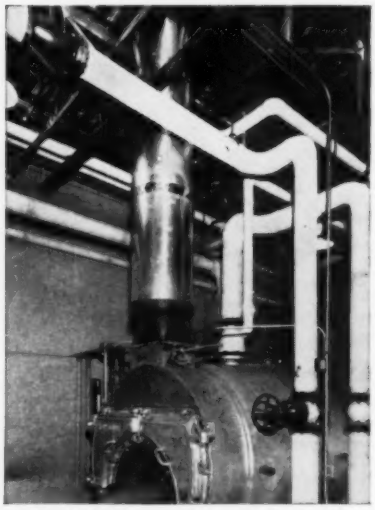

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"open for discussion"

• WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6. N. Michigan Ave., Chicago 2.

Questions Method Used to Estimate School's Fuel Oil Requirements

IN THE ARTICLE *Use Electricity or Oil to Heat This School? . . . Here are Actual Cost Comparisons* (October 1958), Denard L. Gusler has developed an interesting discussion. We would like to call attention, however, to the method used in estimating fuel oil requirements.

In the calculation of annual electric and oil requirements for heating the Virginia school, credit was taken for heat gains from students and electric lighting with both types of systems. This is an accepted practice for estimating heating requirements. However, in the case of estimating the fuel oil requirements, credit was given twice for these heat gains.

Approximate seasonal efficiency for oil fired heating systems is shown on page 466 of the 1958 ASHAE Guide. As explained in the accompanying paragraph, this efficiency takes into account heat gains from lights, occupants, sun, etc. Therefore such credit cannot be taken a second time. This correction in Mr. Gusler's calculation will increase fuel oil requirements about 37.5 percent.

G. G. FREYDER
Heating and Air Conditioning Engineer
Commonwealth Edison Co.
Chicago, Ill.

THE AUTHOR'S REPLY — The efficiency of 70 percent that I used for fuel oil was based on an assumed average of boiler input *vs* boiler output and was not taken from the Guide.

Package oil fired boilers are now obtainable with guaranteed efficiencies of over 80 percent. Therefore it is reasonable to assume an average efficiency of 70 percent. The reader should note that 70 percent efficiency was used for occupied, occupied without ventilation, and non-occupied conditions with all lights turned out and no occupants in the building.

DENARD L. GUSLER
Professional Engineer
Clark, Buhr & Nexsen
Architects — Engineers
Norfolk, Va.

Rate of Odor Regeneration Dictates What Control Method Should Be Used

IN HIS *Winning the Air Conditioning Odor Fight—Round* 5 (May), Albert B. Hubbard sets forth some of the basic mathematical principles involved in odor control. He shows that perceptible improvement in odor level requires a great increase in the use of outside air.

However, when odor is controlled by the use of an adsorbent, such as activated charcoal, it takes relatively little more equipment and expense to do a complete job than to do a partial one. For example, removing 90 percent of the odor in a space reduces the level from strong to moderate, whereas 99 percent removal reduces it from strong to recognizable. These are two odor index steps rather than one. This requires only a small amount of additional adsorbent which works with almost equal efficiency at low concentrations.

Nighttime ventilation is described primarily as it applies to summer air conditioning. This may be applied in other seasons, too, except that some thought must be given to the degree of ventilation and the resultant temperatures within the building.

Perhaps more emphasis should be placed on the rate of odor generation. This is the factor that determines the amount of ventilating air or the degree to which some other control method must be used. An existing odor level within a building has little or no relation to

"open for discussion"

continued

the cost of maintaining a reasonable odor level by ventilation or other means. It is the rate of odor regeneration within the space that is the dictating factor.

H. L. Barnebey
Vice President
Barnebey-Cheney Co.
Columbus, Ohio

"Odor Fight" Series Gives Engineer Basic Concepts of Complex Problem

Albert B. Hubbard's series, *Winning the Air Conditioning Odor Fight*, is doing much to put over the basic concepts of odors and their control. The subject is complex and involves chemical and physiological considerations that are not always within the immediate grasp of the air conditioning engineer. Mr. Hubbard has done much to clarify these items and improve our understanding of the subject.

The theoretical mathematical approach in Round 5 (May) will appeal more to the physicist than to the designing air conditioning engineer who will look for a simpler solution to his problems. However, the basic scientific approach is important in the solution of special problems.

The concept of night ventilation to clear odors from a closed shop, office, or store during the summer season should be very effective in removing the stuffy, smelly conditions existing in the morning when the shop or office is opened. During the heating season this may cause an objectionable heat loss. A year 'round operation using activated charcoal for a portion of the recirculated air may prove more desirable and produce a more uniform atmospheric condition during the working day.

The use of an exhaust system operating only when the compressor is off may result in an atmospheric condition that is not uniformly maintained and is objectionable for some installations. Careful study of such a system should be made before reaching a decision.

Warren Viessman
Mechanical Engineering Consultant for Installations
Air Research & Development Command
U. S. Air Force
Baltimore, Md.

Dehumidification Studies Show Effect Of Two Lengths of Air Flow Paths

I appreciate the answers from readers to my Question of the Month *What Vapor Transmission Rules Apply When Planning for Dehumidification?* (January and February 1958, March 1959).

Since the time that I asked this question, my firm has conducted some experiments which might shed some light on the situation. In order to secure a maintained source of high vapor pressure, a body of water could, I felt, be conveniently used.

In the described procedure that follows, neither the measurements nor the calculations were carried out to a laboratory order of precision. Engineering precision was considered to be accurate enough.

Ordinary tap water was used. Two graduated glass cylinders, each 1.4 in. ID by about 12 in. high, were partially filled with water and placed in a large unoccupied, but heated, room. One of the cylinders was filled almost to the top, while the other had only a few inches of water in it. This was done to observe the effect of two different lengths of air flow paths.

Room conditions were not under close control, but held fairly closely to 80 F and 20 percent relative humidity during the test. For purposes of the calculations, the following set of conditions was used: 80.5 F dry bulb, 56.5 F wet bulb, 19.5 percent RH, 35 F dewpoint, and 0.2 in. Hg vapor pressure.

The water was at about room temperature to start with, and stabilized at about 78 F. This raises the question whether, in determining the vapor pressure of the liquid, the 78 F temperature should be used, or whether it should be assumed that the top film of liquid would be at the wet bulb temperature of the air, as theory calls for. Results were worked out both ways (A and B in the following table). The loss of water by evaporation from each cylinder was measured after exactly 168 hr. The results are tabulated:

	Cylinder No. 1	Cylinder No. 2
Initial distance from top to water level, in.	1.65	8.3
Final distance from top to water level, in.	2.55	8.7
Average distance (flow path), in.	2.1	8.5
Area of water surface, sq in.	1.54	1.54
Vapor pressure in air, in. Hg	0.2	0.2
Vapor pressure of water at 78 F (A), in Hg	0.97	0.97
Vapor pressure of water at 56½ F (B) in. Hg	0.46	0.46
Evaporation in 168 hr, gr	350	155.7
Evaporation per hr per sq ft of surface, gr	194	86.5
Evaporation per hr per sq ft per in. Hg (A), gr	252	112.3
Evaporation per hr per sq ft per in. Hg (B), gr	745	332.5
Evaporation per hr per sq ft per in. Hg. per in. (Flow path A), per in.	528	955
Evaporation per hr per sq ft per in. Hg. per in. (Flow path B) per in.	1560	2830

These results bring the following comments:

1) For cylinder No. 1 (2.1 in. flow path), using vapor pressure differential based on actual water temperature (A), the test works out to 528 perm in., compared with 120 given in the ASHAE Guide.

2) For cylinder No. 2 (8.5 in. flow path) the corresponding figure is 955 perm in., indicating that the evaporation rate is not inversely proportional to the length of flow path within the cylinder.

3) Results using the liquid vapor pressure corresponding to the measured temperature in the body of the liquid are closer to the Guide value than using the liquid vapor pressure corresponding to the wet bulb of the air.

4) Assuming the permeability figure in the Guide (210 perm in.) is correct, my test figures are wrong on the high side.

Comments by an expert on the above findings would be very welcome.

H. P. Waechter
Chief Engineer
United Merchants Laboratories, Inc.
New York, N.Y.

What Causes Great Drop in Liquid Temperature Due to Flash Effect?

IN HIS ARTICLE *High Temperature Water Heats New School* (March), J. S. Blossom makes an interesting point. One could design or purchase most any style of heat emitting device that would harmonize with other fixtures in the room. With HTW, the size of the heating units, regardless of style would be considerably reduced over designs used for our presently accepted equipment. What I would like is an explanation of the great reduction in liquid temperature due to flashing.

If a rupture occurred in a pipe containing 350 F water, part of the water that would pass through the rupture into the atmosphere would immediately flash into steam. The heat absorbed from the water by the flash steam would cool the water to 212 F, the saturation temperature of steam at standard atmospheric pressure.

What then is Mr. Blossom's explanation for the water cooling down to 130 F? Could it be due to evaporative cooling as it sprays from the rupture?

JAMES C. BISHOP
Plant Engineer
Detroit, Mich.

THE AUTHOR'S REPLY — The question raised by Mr. Bishop is a logical one and one that we have tried to answer to ourselves before. We have pursued this subject with several thermodynamists in order to develop a rational scientific explanation. However, the number of variables affecting the end result upon emission of the mixture from the break is so great that the authorities that we have contacted have been unable to provide a direct mathematical solution up to this time.

The following summarizes the physical nature of this action as best as we have been able to understand it: When a break occurs in an HTW line, a mixture of water and steam is discharged into the atmosphere. Since the temperature of the water is well above its vaporization point at atmospheric pressure, the heat energy in the water is used to convert part of the water from its liquid state into a vapor. The quantity of heat available is sufficient to vaporize only from 20 to 25 percent of the HTW present. Due to the pressure in the system, the mixture of steam and water will be ejected initially at a high velocity. Since the pressure is maintained independently by a fixed quantity of nitrogen in the compression tank, the pressure will fall rapidly and the velocity of the ejection will drop to a low value in a short space of time.

When the 25 percent of the water vaporizes, it obtains this heat energy from the accompanying 75 percent of the water. The heat content of the 75 percent water is reduced by that heat which is used to vaporize the 25 percent.

The thermodynamics of this cooling process may be compared to the throttling effect of a refrigeration expansion valve.

Two additional physical reactions cause further cooling to take place in the mixture of steam and water immediately upon release from the pipe. First, the expansion of the steam causes some added cooling of the mass. Second, the formation of steam upon the drop in pressure at the break occurs intimately throughout the mass being discharged. This exposes a large water surface area to the atmosphere which produces adiabatic cooling, tending to approach the ambient wet bulb.

For HTW at 400 F, the resulting emission temperature of the mixture has been between 120 and 140 F. This reaction has been observed in three actual laboratory and field tests made in different locations over the past several years.

I hope that this explanation will give Mr. Bishop the answer desired, and that others will analyze this question and provide answers which may lead to more thought and discussion on the subject.

JOHN S. BLOSSOM
Ziel-Blossom & Associates
Consulting Engineers
Cincinnati, Ohio

Slot Exhaust Data Seems Inconsistent With That Presented in Literature

A. B. EPPLE'S article *What Are Limits of Slot Exhaust?* (December 1958) was most interesting. He is to be commended for bringing forward a number of points about slot exhaust ventilation which are often misunderstood.

His illustrations show clearly the effect of crossdrafts caused by personnel movement and he brings out very well the importance of designing ventilation on the volume of air to be exhausted rather than attempting to achieve control with slot velocity alone. In this connection he also points out that high slot velocities not only give no improvement in operation, but also require higher "hood suctions" or correspondingly higher operating costs for the system.

I am disturbed, however, by the velocity contours which he has reported and the value of the velocities shown. It is inconceivable to me that accurate measurements of velocities less than 50 fpm can be made, even under ideal conditions. Velocity measurements in the range of 5 to 8 fpm would seem to be impossible.

In the literature, Brandt, Silverman, and other investigators have indicated that slot control can be related to a cylindrical analogy and that the formula $Q = KLVX$ applies; *where* Q = exhaust volume, K = a constant, L = length of slot in ft, V = velocity in fpm, and X = capture distance in ft. (Capture distance is the width of tank, or the distance from the slot to the edge of the tank.)

These investigators report values of K ranging from 3.7 for unflanged slots to 2.8 for flanged slots of the type shown. These values have stood up well in ventilation practice and are the bases for most systems of cal-

culation for tank and slot control air volumes. When these accepted constants in the given formula are applied to Professor Epple's data, they yield point velocities considerably higher than those which he has reported. Further, the numerical values do not agree well with accepted values previously determined. Conversely, his data, when fitted to the accepted equation, shows values of K ranging from 7.9 to 25 for 1120 cfm exhaust volume and 6.9 to 22.6 for the 1900 cfm exhaust.

Since this data is at variance with that of previous investigators and since it affects the basic design criteria, we feel that this point should be brought forth for discussion.

JAMES C. BARRETT
Ventilation Engineer
Div. of Occupational Health
Michigan Dept. of Health
Lansing, Mich.

THE AUTHOR'S REPLY—I too am skeptical of low velocity air flow readings as I am sure everyone else is who has had experience in these determinations. I put the values on the contour lines as they were read, trusting the readers would allow some variation either way on the low values.

Every effort was made to get the best values possible. The heated wire anemometer used had recently been calibrated at the factory, and the students taking the readings had some practice with the meter on other tests. It was for these reasons that I believed the values to be correct.

At the time this test was made I was trying to show my students the flow resulting from different values of cfm per sq ft of tank surface. I was therefore not so much interested in the actual values of velocity as in the picture of what resulted when different volumes per sq ft were used.

I cannot offer to run a check test because the whole laboratory has been dismantled and there are no plans for setting up another.

A. B. EPPLE
Associate Professor
Dept. of Mechanical Engineering
University of Michigan
College of Engineering
Ann Arbor, Mich.

Maybe Threads Were Poorly Cut, Letting Erosive Vapor Escape

WE HAVE NOTED with interest the answers to the Question of the Month "*What Causes Our Pipe Fittings to Fail?*" (May). Based on our experience, we would like to offer J.B.S. another possible solution.

Our organization has experienced something like this with respect to 100 psig steam lines. The fact that the threads are affected mainly may simply show that they were badly cut to begin with and not made tight. In screwing into a valve, one is always careful not to overdo it anyway.

Escaping vapor, in small quantity and not necessarily conspicuous, could erode the threads. Then, when air is sucked back by vacuum after cooling, corrosion could result.

J.B.S. might check his thread cutting equipment and the way it is being used. Some pipe fitters don't take the trouble to use cutting oil. A good thread compound should be used, such as water soluble graphite paste—not too thin—which will permit an extra thread to screw in.

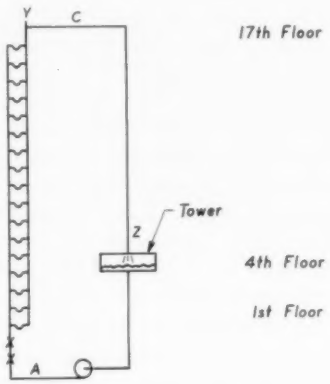
"Electrolytic action" often is the convenient whipping boy for poor workmanship. There is such an animal, of course, but just because it does its dirty work in such a sneaky manner is no reason to blame it for everything.

WALTER OTTO
W. Otto Bros. Maintenance Co.
Forest Hills, N. Y.

Condensers Must Have Reverse Return; Install Valves, Size Pump Sump

I WOULD like to submit still another answer to the Question of the Month *What Is Correct Pump Head for Cooling Tower Piping?* (October, November, and December 1958).

J. A. W. should not attempt to pipe his condensers with other than a reverse return, as shown below. Install a check or checks in line A to hold approximately 80 psig back pressure on shutdown. If line C is to be vented at Y, then the pump sump must be large enough to hold the contents of line C on shut-



down without overflowing. If an amply sized pressure valve is used at Z and set at about 60 psig, the system will stay full on shutdown.

Under these conditions the head will be 143 ft (13 floors at 13 ft each) plus the head of the most restricted condenser.

JOSEPH L. PINTER
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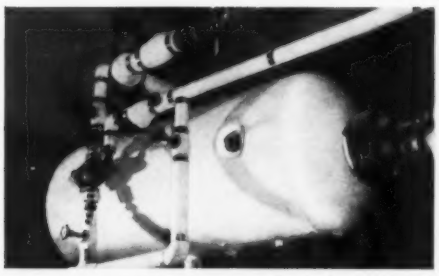

Inside hospital operating rooms, temperature and humidity must remain constant.

At new Sinai Hospital the job is done by steam. Steam generated by 3 RECO steam generators, which supply steam to humidifiers for the control of relative humidity in more than 16 operating rooms.

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CONVERTERS STORAGE HEATERS INSTANTANEOUS HEATERS HEAT RECLAIMERS STORAGE TANKS

RICHMOND ENGINEERING CO., INC.

question of the month

"How Can Fan Be Cleaned?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other answers or comments for publication are invited.

"A large centrifugal fan exhausts air containing sal ammonia from an industrial process. The fan becomes heavily coated with this chemical within a very few days and must be thoroughly cleaned often.

"What is the most effective method for cleaning the impeller and housing for this fan?"—C.S.G.

Why Not a Permanent Steam Connection To Fan for Daily Cleaning?

As WE understand it, this substance is ammonium chloride, with the chemical formula NH_4Cl. This compound is soluble in hot water. Presumably, steam cleaning of the fan would represent the best approach.

Possibly something like this is already being done, and what C.S.G. is particularly concerned with is the necessity of dismantling the duct assembly every few days for the cleaning process. If this is the case, it might be a good idea to make a permanent steam connection to the unit, perhaps with a header arrangement within the housing so that the interior might be thoroughly cleaned by high pressure steam at the end of each day's operation. This would make it unnecessary to do any disassembly work, and also prevent any substantial buildup of deposit.

C. W. DEXTER
Vice President
Ilg Electric Ventilating Co.
Chicago, Ill.

Install Fan with Fewer Blades; They Will Wipe Themselves Clean

ALTHOUGH C.S.G. does not describe the type of fan being used, it would be our guess that it was not one with a flat radial blade. The forward curve type is notorious for its tendency to hold airborne material in the cup formed by the blade. The backwardly inclined fan will also hold material, particularly if it is sticky or hygroscopic.

The best solution we can offer is to replace the fan with one that has a wheel with relatively few blades. These blades should be flat and set radially. Such a fan provides large air passages, and tends to wipe itself clean since there are no curved surfaces to hold material.

This type of fan has air flowing through the housing at a higher velocity with fewer turbulent areas and has less tendency to collect material.

C. J. TRICKLER
Chief Engineer
The New York Blower Co.
La Porte, Ind.

Either Dilute Fume Laden Air or Raise Fan Temperature Above Dewpoint

THE MOST EFFECTIVE way to clean the fan is to wash it with warm water. But the best way to handle the situation overall is to keep the fan from coating with sal ammonia in the first place. One way to do this is to dilute the fume-laden air sufficiently to lower its sal ammonia dewpoint below the temperature of the exhauster. This is probably quite low in the morning.

Another way is to raise the temperature of the fan above that dewpoint. This can be done with infra-red radiant heaters focused on the exhauster blades and inside the housing surface.

SIEGFRIED RUPPRIGHT
Professional Engineer and Consultant
Inglewood, Calif.

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Use Low Pressure Steam, Since Sal Ammonia Is Water Soluble

THE BEST WAY to clean a fan in this application would be to use low pressure steam inasmuch as ammonium chloride or sal ammonia is water soluble. This fan, of course, should preferably be equipped with an access door and a drain plug, and the steam should be introduced through the access door and/or the inlet.

WILLIAM M. GELVIN
Sales Engineer
Fan & Blower Div.
The Peerless Electric Co.
Warren, Ohio

Investigate Possible Preventives, Such as Water Wash System

WHILE HAVING had no direct contact with the specific problem involved, it is our opinion that steam cleaning would be the quickest and most effective solution. An investigation as to a preventative to the situation would most certainly be in order. Whether or not a water wash system prior to the fan would alleviate the condition could be determined by consulting with some of the manufacturers of such wash systems.

L. P. HANSON
Sales Manager
Barry Blower Co.
Minneapolis, Minn.

Install Water Spray, Eliminator Section Between Process and Fan

THE CORRECT METHOD of eliminating the frequent cleaning of an exhaust fan is the installation of a water spray and eliminator section between the process and fan. If water in the sprayer is heated to 120 F, absorption of ammonia chloride is greatly increased (500 parts by weight of ammonia chloride to 1000 parts of water), resulting in a reduced water rate.

E. V. AGEE
Chief Engineer
Blower Div.
Aladdin Heating Corp.
San Leandro, Calif.

Most Economical Method Would Be To Enter Fan, Wash Down by Hand

FIRST OF ALL, we have assumed that these fumes are from a galvanizing process.

There are several methods of cleaning this fan, and the most economical method would be to periodically enter the fan through an access door if one is available and wash the fan down with water by hand. Since this is an existing fan, this method would be the most likely one to use.

If this had been a new project and the fan not been selected, it possibly could have been furnished with a set of fog nozzles and also coated with a protective coating which will resist corrosion due to the water. Then it would be a simple matter to wash the fan down with the fog nozzles and provide a drain for carryoff of the water and chemical. However, as this is an existing installation it would be extremely difficult to coat the fan with such a protective coating because this is usually baked on.

Another method would be to furnish a hydraulic scrubbing tower to wash the air before it enters the fan.

C. F. KUNZ
Engineer
Buffalo Forge Co.
Buffalo, N. Y.

Use Noncorrosive Chemical Solvent; Consider Filtering Air Stream

GENERALLY SPEAKING, the fan is supposed to be protected from any airborne contamination which might be deposited within the casing and especially on the wheel. It is always hard to clean the inside of a fan, since the unit has to be disassembled to do a thorough job.

In the cleaning process, a chemical should be used which is a good solvent for the deposited salts or other contamination, but which does not corrode the metal parts.

We suggest that C.S.G. install a suitable filter in the air stream ahead of the fan. This filter can be mounted on the sliding panel and should be easily removable for changing or cleaning.

If this latter suggestion is tenable, he must compensate in blower speed for the static pressure drop caused by the filter.

PETER KARDOS
Chief Engineer
Morrison Products, Inc.
Cleveland, Ohio

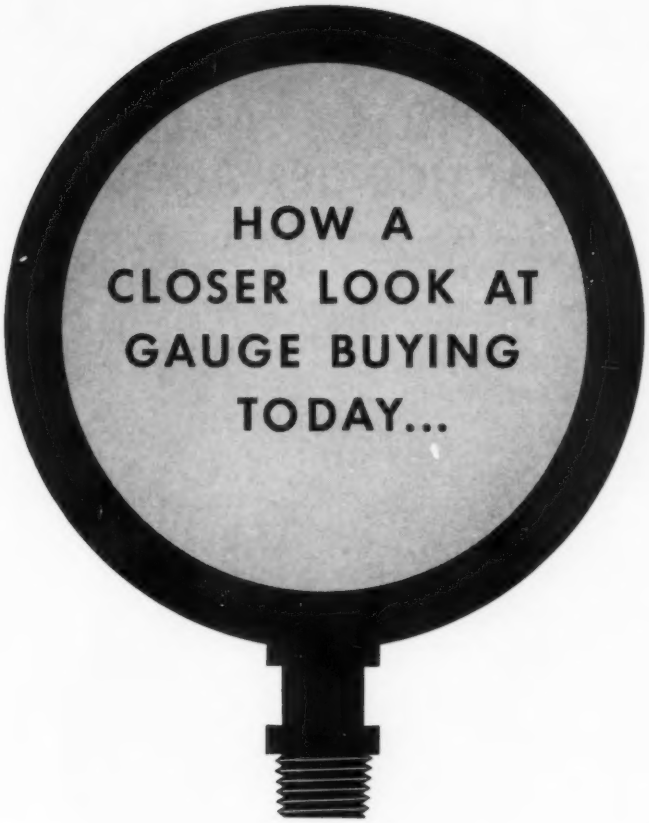
READER ASKS —

"What Are Flow Characteristics Of Butterfly Valves, Dampers?"

"There is a dearth of knowledge on the action of butterfly valves placed in pipes handling liquids and of butterfly dampers in air ducts.

"Some concrete information on fluid flow characteristics when the valve or damper assumes various positions of full open or full closed would be welcome. Also, data on pressure drop in various positions of opening would be helpful."—F.A.R.

• *YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*



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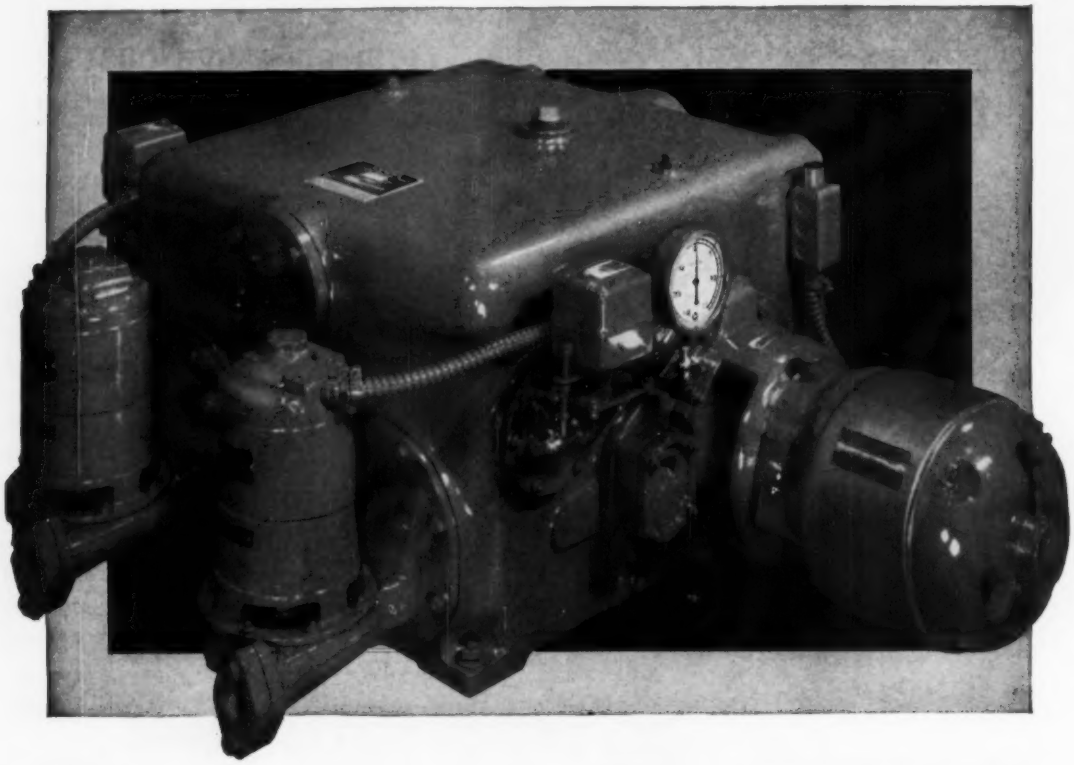

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
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PRINCIPAL SPEAKERS on MCAA pipe welding panel were, left to right: Robert S. Green, consultant to Pipe Welding Bureau; J. O. Cavanagh, Alloy Rods Co.; William E. Maloney, chairman of MCAA's pipe welding committee

Pipe Welding Panelists Pool Know-how; Focus on New Cost Saving Techniques

. . . new procedures stimulate lively discussion at MCAA annual convention

AN ACTIVE panel discussion on new pipe welding procedures was a highlight of the 70th annual convention of the Mechanical Contractors Association of America held recently in Washington.

William E. Maloney, Buffalo, chairman of the association's welding committee, opened the panel, remarking on the strides that are being made in developing new techniques and equipment. He pointed out that the piping contractor is constantly testing and conducting research in the field with new pipe metals, new and improved electrodes, field erection methods, and automatic pipe welding equipment — all in an effort to cut labor costs and increase the safety of the worker.

He stressed the importance of qualifying the pipe welder to do the kind of job required today by the trend toward higher pressures and temperatures and increasingly critical processes.

Professor Robert S. Green of Ohio State University, consultant to the Pipe Welding Bureau, reported that the new *Standard Manual on Pipe Welding* has been completed. This new instruction manual contains all the basic information needed to teach pipe fitter apprentices how to weld pipe. He urged its use in all apprentice training programs. A supplement on soldering and brazing is in preparation, he said.

Panel guest J. O. Cavanagh, vice president in charge of research for Alloy Rods Co., was asked to present some information about new and improved welding procedures as related to electrodes. Calling on his more than 20 years of welding experience, he traced the evolution of EXX18 welding electrodes by recalling how some of the shortcomings of the EXX10 electrodes could be overcome by a new type of coating.

Cracking of weldments, particularly in the parent metal close to the weld, occurred with too much regularity when welding hardenable steels with the 10 type electrodes, he said. The difficulty was found to be associated with hydrogen generated in the arc atmosphere, due to the high cellulose and water content of such coatings. Hydrogen penetrated the parent metal, creating the cracking.

This led to the development of a new type of coating, free of cellulose and as low as possible in water content. The name "low hydrogen" was applied to this electrode, and the type was identified as EXX16.

In spite of great progress, this electrode left something to be desired from the usability standpoint, Mr. Cavanagh continued. Extreme care in starting electrodes and in maintaining exact arc lengths was necessary to avoid porosity. Bead contour was such that slag could be trapped along the edges of multiple pass welds, particularly in vertical and overhead positions, he said.

Increase Weld Quality, Speed

About five years ago a radical improvement was introduced in the low hydrogen electrode field. Iron powder was introduced into the coating and other ingredients were modified. The result was an electrode, EXX18, that overcame most of the shortcomings of the EXX16 type. Starting porosity was eliminated, bead contour was improved, spatter losses were reduced, arc length control was almost automatic. But, best of all, deposition rates were increased to a point where any given electrode diameter was frequently equivalent to the next largest diameter of conventional electrodes. For example, a 1/8 in. electrode of the 18 series would deposit weld metal as rapidly as a 5/32 in. electrode of the 16 series.

According to Mr. Cavanagh, the more rapid rate of depositing weld metal is due to the fact that the iron powder in the coating helps to conduct the welding current, and in addition it is melted and added to the weld metal. This means that higher welding currents can be used, and the current is used more efficiently.

Physical properties of the EXX18 are even superior to those of the 16 series, particularly in impact properties of many of the alloy steels, he said. Perfect x-ray quality of weld metal is easily produced with the 18 series.

One fabricator has reduced re-work on x-ray quality field welding from an average of 8 percent to less than 1 percent. This was not pipe welding, but did involve pressure vessel welding in all positions, Mr. Cavanagh reported.

The EXX18 or 18 series electrodes, as applied to pipe welding, provides many advantages. It is not to be considered a universal electrode, no more than any other electrode that has been produced up to this time. No single type of electrode is best suited for all phases of pipe welding because of the complexity of the situations encountered and the high quality requirements. Some of these requirements were given by Mr. Cavanagh as a flat, smooth bead contour being ideal for pipe welding since it minimizes preparation before subsequent layers of weld metal are to be applied. Another is freedom from undercutting at groove edges. This is essential to avoid slag entrapment or porosity. Also, he mentioned easy and complete slag removal being required for weld quality and cost savings.

When correct diameter, welding current, and welding procedures are used, EXX18 electrodes will meet all of these requirements. Electrode diameters recommended may not be those normally used with other types. However, the completed joint must be the consideration when evaluating if the electrode and procedure selected is the most satisfactory from the standpoint of quality and cost, he stressed.

Working with many fabricators of pressure piping, procedures have been worked out which produce ideal weldments. Using a backup or chill ring, 3/32 in. diameter series 18 electrodes should be used in the root pass, he advised. The groove opening should be big enough for the electrode to be easily manipulated. In heavy wall pipe, where the bevel is a small angle of 10 to 15 deg, this means that it may also be necessary to use 3/32 in. electrodes for the second and third layers of the weld. In the case of thinner wall pipe, with a bevel of 20 to 30 deg, 1/8 in. electrodes may be used from the second layer to completion. It is generally recommended that 1/8 in. electrodes should be the largest size used for pipes in the horizontal position with the joint in a vertical plane.

These recommendations are made on the basis that 3/32 in. series 18 electrodes will deposit weld metal as fast as EXX10 or EXX16 electrodes in 1/8 in. diameter, that 1/8 in. series 18 electrodes will deposit weld metal as fast as 5/32 in. series 10 and 16 electrodes, and that the beads will be absolutely flat, smooth, with no undercut, and the slag completely removable by a slight scrape with a tool or the end of an electrode.

No Chipping, Grinding Necessary

This means that no chipping nor grinding of welds is necessary. One fabricator had a welding arc time of 5 hr on a 12 in. diam. 2½ in. wall thickness pipe. It was necessary to chip slag and completely grind each layer of the weld (requiring over 4 hr) before adopting EXX18 electrodes for this welding. After going to series 18 electrodes, all chipping and grinding time was eliminated and an overall saving of over 4 hr per joint was effected. Figuring 50 percent arc time, the overall time per joint was cut from 14 to 10 hr, or a saving of over 28 percent, he said.

Mr. Cavanagh reported that actual deposition tests of 3/32 in. series 18 *vs* 1/8 in. EXX10 show that both will deposit 1.70 lb of weld metal per hr at 100 amperes in vertical joints with the pipe in the horizontal position. He said that welding operators prefer to use series 18 electrodes because of their ease of use and particularly because of their lack of spatter. This is important, particularly when working in the 6 o'clock to 3 o'clock or 9 o'clock positions.

Comparing 1/8 in. EXX18 and 5/32 in. EXX10 or EXX16 for deposition rates, each will deposit about 2.75 lb per hr at 140 amperes. The gross efficiency (pounds of weld metal deposited per 100 lb of electrodes purchased with 2 in. stubs discarded) is 64.3 for the 18 series *vs* 60.7 for the series 10 and 16, a saving of almost 6 percent, he said.

CLOSEUP VIEWS of pipe welds show contours of various weld metal layers in (left) 3 to 12 o'clock section, (right) 6 to 9 o'clock section. All welds were cleaned by merely scraping slag off with end of electrode, wire brushing

The recommendation that electrode diameters be limited to 1/8 in. for the horizontal (5-G) position is a general one. There may be cases where, with heavy wall and wider groove openings toward the completion of the joint, that the 5/32 in. diameter electrode may be used. However, the electrode diameter should be kept down to one diameter smaller than would be used with the EXX10 type, Mr. Cavanagh recommended.

Joints in the 2-G position (pipe vertical, joint horizontal) generally can be made with 18 series electrodes of 5/32 in. diameter after the first few passes. This again depends on the available space to manipulate the electrodes. It has been found from actual tests, however, that the welding current permissible when using 1/8 in. diameter electrode is as high as that which can be used with 5/32 in. Since deposition rates are dependent almost entirely on the amount of welding current, the 1/8 in. diameter being easier to handle is preferred.

Use Chill Rings for Root Passes

As with any process there are a few do's and don'ts, Mr. Cavanagh cautioned. First, the EXX18 electrodes are recommended for root passes only when chill rings are used. This is because, in the case of open joints with or without lands or in tight joints with lands thin enough to penetrate, the slag of the 18 series — and also the 16 series — is so dense that it depresses the bead on the inside of the pipe at the 6 to 8 o'clock (overhead) position. This condition is not satisfactory for pressure piping. Vertical down welding should not be attempted with series 18 electrodes, he stressed.

Tungsten inert gas welding of root passes is generally used for tight joints, with no filler metal added. Joints which are not tight require a filler metal to be added with the "TIG" process, or sometimes EXX10 electrodes are used. The slag formed by 10 series electrodes is very porous and of low density. Therefore, the slag does not depress the bead on the inside of the pipe.

Electrode Should Be Perpendicular to Pipe

Mr. Cavanagh pointed out that welding procedures differ slightly from those considered most suitable for conventional electrodes. Starting from the bottom of a 5-G positioned joint (pipe horizontal, weld vertical), normally the electrode is inclined upward in the direction of travel. The recommended procedure with series 18 electrodes is to keep the electrode at a right angle with the pipe, or in line with its diameter.

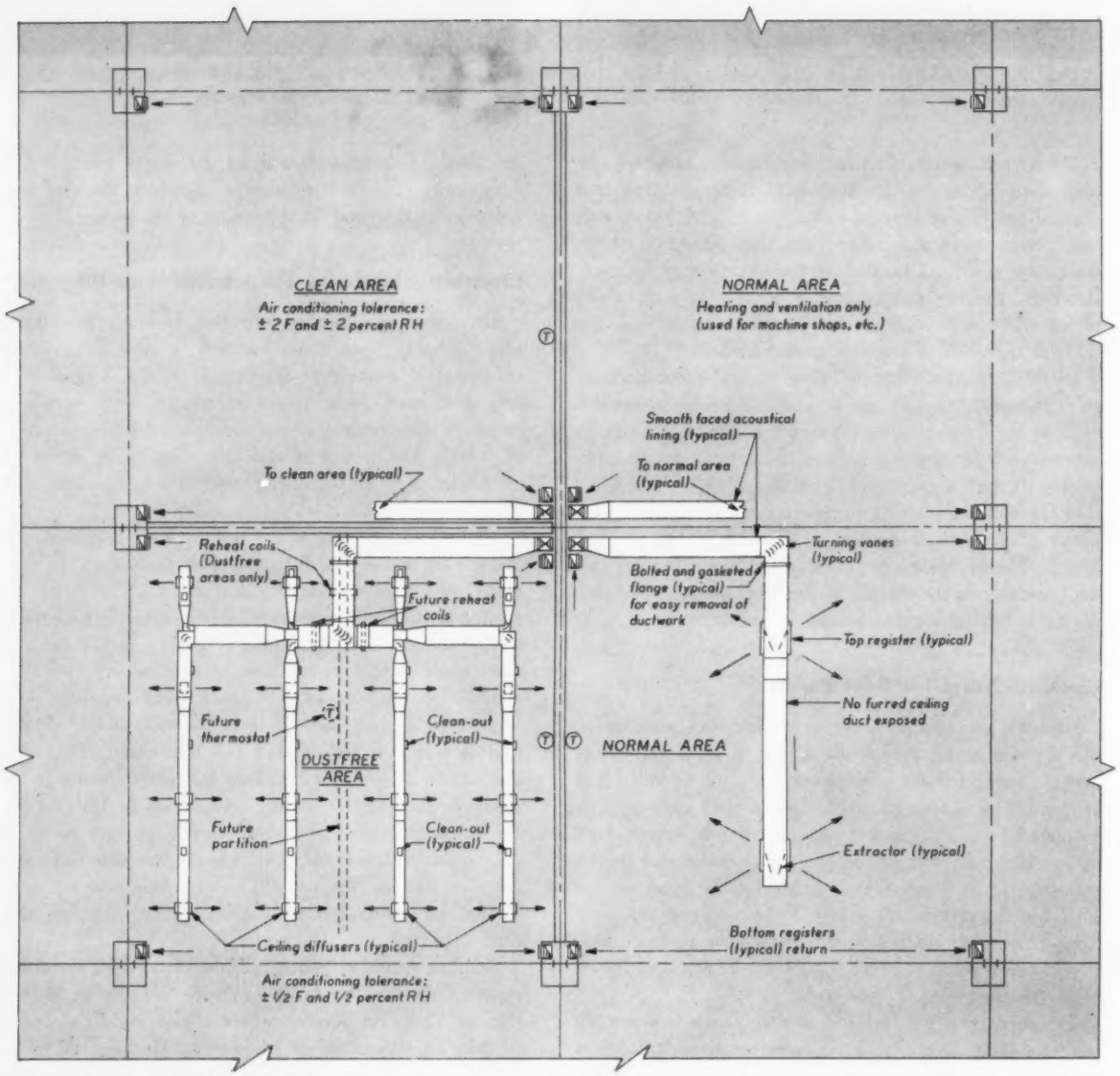
The EXX10 electrodes are usually kept perpendicular to the axis of the pipe in weaving or oscillating the electrode in the groove width, but the EXX18 electrodes should be tilted on approaching the side of the groove so that the arc is directed into it, tending to become at a right angle to the groove face, he concluded.

The question was asked if the EXX18 electrode were limited to carbon steel piping. Mr. Cavanagh replied that it was not. He pointed out that extra manganese and silicon as well as chromium and molybdenum in the electrode increase its tensile strength up to 120,000 psi. He did emphasize that it was very important to use a steady arc with no whipping when using this electrode. He also stressed the use of an electrode one diameter smaller than normal to avoid grinding and chipping after each weld pass.

Another question concerned ductility. Mr. Cavanagh reported that the series 18 electrode permits an elongation of 32 to 35 percent where the series 10 electrode permits an elongation of 25 percent. He referred to the ASME Pipe Welding Standard F4 which lists the properties of this new 18 series. ≠

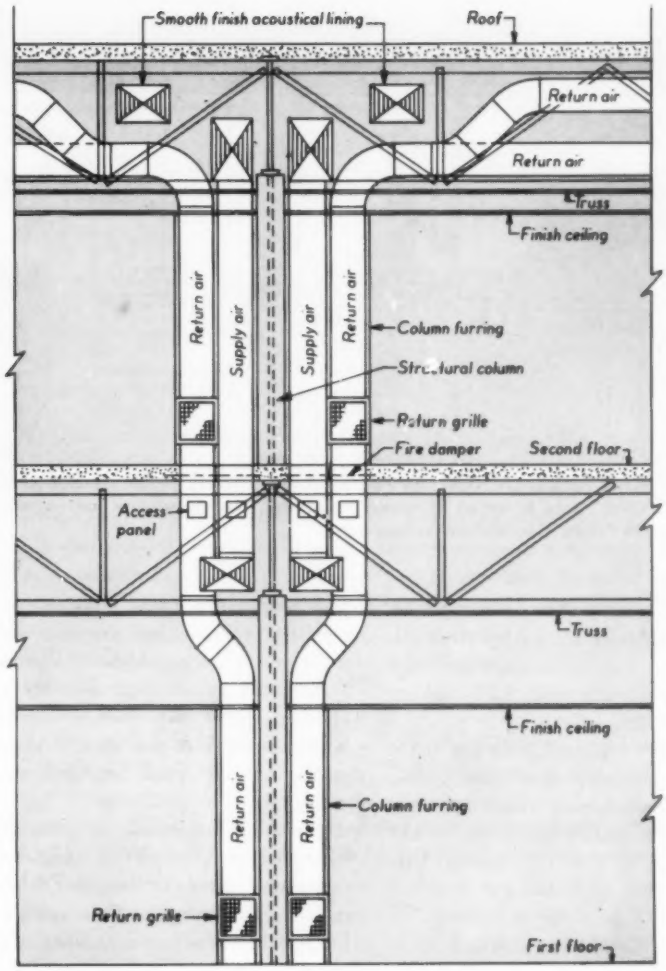
Four Sets of Conditions Demand Unusua and Flexible System

. . . to meet variety of temperature, humidity, requirements in new electro-mechanical aircraft



TYPICAL DUCT ARRANGEMENT for "normal," "clean," and "dustfree" areas shown here. Areas are designed to be interchangeable, requiring only slight modification in fan housings on roof. All partitions are movable, so room sizes can be changed

dust control components plant



SINCE COLUMNS are only stationary items in building, furred space around columns is used to accommodate supply and return air ducts. Access panels are provided for periodic vacuum cleaning of ducts

• The unique structural design of a recently completed manufacturing and testing plant for aircraft electro-mechanical components has resulted in an equally unique air conditioning system. With four distinctly different sets of air conditioning and ventilation requirements, the building is divided into four areas by movable partitions. These areas may be increased or decreased at any time to accommodate some new production procedure requiring either more or less critical temperature, relative humidity, and dust control tolerances. How this was accomplished is told here.

The author was born in Russia at the beginning of the century and, via Istanbul, Egypt, Turkey, and France, migrated to the U. S. in 1923. He worked his way through New York University and Pratt Institute, graduating from NYU in aeronautical engineering. After serving in various engineering capacities with the Government and with several architectural and engineering firms, today he is a consulting mechanical engineer in Los Angeles.

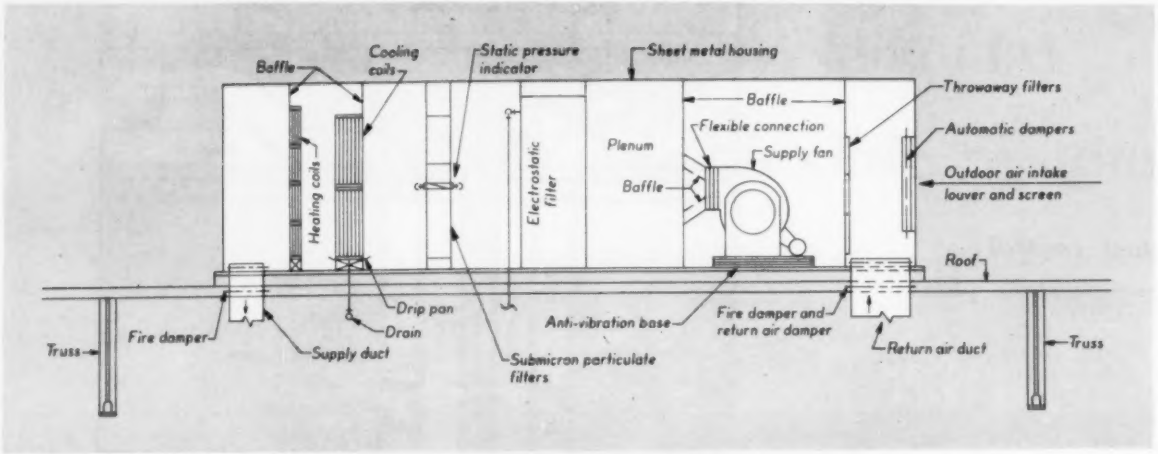
BY BORIS M. LEMOS
Consulting Mechanical Engineer

THE PROBLEM of air conditioning a 320 ft × 320 ft, two-story building for the manufacture and testing of highly sensitive electro-mechanical components for aircraft was a design challenge. The system must afford the flexibility to permit changes and building expansion and must maintain varying degrees of close temperature and relative humidity tolerances according to the needs of four specific areas:

1) Shop areas are to be served by heating and ventilating systems only.

2) The "clean" area, for manu-

Fan housing affords ultimate flexibility



FAN HOUSING ARRANGEMENT for "dustfree" area consists of fan, outdoor air intake, cooling and heating coils, and three types of filters. "Clean" area is served by same arrangement, less electrostatic and submicron particulate filters. "Normal" areas have fan houses same as "clean," but without cooling coils

facturing certain equipment, must be conditioned with reasonably clean air and kept within temperature and humidity tolerances of ±2 F and ± 2 percent RH.

3) The "dustfree" area, for more critical manufacturing procedures, must be maintained within temperature and humidity variations of not more than ½ F and ½ percent RH. Dust particle size cannot exceed 0.3 microns.

4) The fourth area, termed "permanent space," is made up of service areas that will not be subject to changes in air conditioning requirements. These are kept at 75 F and 50 percent RH.

These areas had to be designed so that they could be interchangeable with slight modifications; i.e., the "clean" area could become a "dustfree" area, etc. All partitions were to be movable so that sizes of rooms could be increased or decreased. The entire building was to be designed on 10 ft modules.

Use Columns for Air Ducts

As the only stationary items in the building are the columns, it was decided to use the furred space of the columns to accommodate the supply and return air ducts. Flange connections for each bay are near the main duct for the purpose of disconnecting the entire duct assembly if another type of duct assembly should be required. Thus, new duct arrangements can be made quickly and easily.

Fan houses, located on the roof, have been designed so that additional equipment could be installed when desired. For instance, the fan unit for the "dustfree" area consists of a fan housing, fan, outdoor air intake louvers, cooling and heating coils, and throwaway, electrostatic, and submicron particulate air filters. The "clean" area is served by a fan of the same size, also in an enclosure. However, this housing does not include electrostatic and submicron particulate filters. "Normal" areas have fan houses same as "clean," but without cooling coils.

Space has been provided in each fan housing so that any time the "clean" and "normal" areas must be changed, the additional coils and filters can be installed with ease.

Keep Out Unfiltered Air

Fan units are of the "push-through" type. These were selected because the entire portion of each fan on the discharge side had to be under positive pressure in order to keep unfiltered outside air from entering through possible cracks and mixing with the already filtered air. Also, the cooling and heating coils were located in a smaller section for easy removal and interchangeability.

The total tonnage for the present air conditioning requirements—500 tons—is served by four refrigerant No. 12 reciprocating compressors and a cooling tower. Heating is provided by two packaged gas-oil fired boilers, each rated 5.1 million Btu per hr and located in the boiler room.

Piping in Portable Columns

The building is also provided with various other utilities. Among these are water, vacuum, compressed air, and nitrogen systems. Grid-pattern piping is run at the ceilings of both floors, with quick couplings spaced every 20 ft for connecting portable service columns. These columns accommodate the requirements of each particular department and contain all service risers of these utilities. Each column has an access panel on one side for connecting the hoses of the various utilities. Columns are never more than 20 ft from any work table. ∓

LESTER T. AVERY, author of this feature, is president of Avery Engineering Co., Cleveland mechanical contractor, and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors. On this page, which appears regularly, he reflects on his installation experiences.

How to Fight a Slugger

TELL a 12-year-old little leaguer he's a "slugger" and he immediately bursts with pride. When a boxer "comes up slugging" he demands awesome respect. But when it comes to a refrigeration machine or system, a slugger can be anything from a nuisance to a downright disaster.

In refrigeration parlance, "slugging" occurs when a slop-over of liquid comes back through the suction lines to the compressor. This causes the pistons to try to compress liquid instead of gas. You hear it, sometimes you feel it, and sometimes the machine feels it. If the machine feels it too hard, the result can be broken valves, broken valve plates, or broken cylinder heads.

There is nothing new about slugging in refrigeration. The early practice in ammonia refrigeration called for surge drums or accumulators in which the unboiled liquid would accumulate, permitting the compressor to operate on saturated or slightly superheated gas. The double-acting type could have very serious accidents if a slug of liquor hit the piston head and caused a breakup of the cylinder.

Later ammonia machines of the vertical single acting type were built with spring releases on the cylinder heads so that a slug of liquor would cause the cylinder head to lift and thus prevent mechanical damage. On those systems slugging was a periodic problem, particularly when a machine which had been shut down for any length of time was started up. There were no automatic pump-down circuits nor valves which held tight.

Then along came the hydrocarbon refrigerants. The characteristics of each seems to be somewhat different. Entrainment of oil caused the first notice to be taken of slugging, which led to observation that refrigerant No. 12 had to run at 30 to 40 F superheat to prevent liquid entrainment troubles. For refrigerant No. 22 it was found that 30 F superheat was too hot, and the instructions were to hold the superheat to 10 F.

Modern design calls for a slug eliminator, surge drum, slop-over tank or something in which you can hold the liquor which has not been boiled in the coil and which will be held in suction lines and not washed over into the compressor.

One of the quickest ways to detect liquor slop-over is to feel the discharge line. If you get pulsations of coolness mixed in with the heat of compression you know you've got some liquor going through. Some valves and cylinder heads handle it better than others.

So, in refrigeration, *nobody* likes a slugger. Pumping down circuits before shutting down will help. Very careful cleaning of refrigerant lines, with permanent installation of dryers and dirt traps to keep dirt from holding expansion valves open, will likewise help. Also, proper balance of coil circuits and compressor unloaders and control of compressor discharge and suction pressures are important.

All of this adds up to the conclusion that the refrigeration machine is part of a cycle—part of a circuit—and the components are just as important as the compressor. Many compressors have been ruined because of troubles of the system. The careful engineer will therefore add slop-over protection.

In discussing the values of the five-year warranty, I think it is pretty well recognized that one value to the customer is that the liquor slop-over damage is being taken by the manufacturer. What will happen after the fifth year is probably something else again. Pretty soon a lot of machines are going to be running out of the fifth-year warranty.

Today, too much emphasis seems to be on lower first cost instead of more dependable operation. Maybe it's expecting too much, but it seems to me that the growth and profit possibilities in the air conditioning business tie pretty much into the quality of the product and the freedom from service.

The system is supposed to be automatic under *all* conditions, but has peculiar operating problems, particularly under light load or fluctuating pressure conditions. It's like saying that an automobile that works wonderfully at 70 mph isn't any good at 30. Slugging is part of the problem and the point of prudence is to try our best to reduce it and even eliminate it. The problem is now recognized and *half* solved. How about the other half? ‡

INDUSTRIAL VENTILATION:

How to Design Freeze Protection For Makeup Supply Air Systems

● The cold siege of the past winter has manifested freeze-up problems which require careful design consideration if they are to be solved. System inlets and dampers must be designed and located to afford uniform air flow. Face and bypass damper control, frequently used as a safeguard against freezing, is often inadequate if some inherent "bugs" are not ironed-out. Air heaters must be chosen, arranged, and sized judiciously. The author favors a single-row preheater over its two-row counterpart. Poor fan selection can be a major cause of stratification and control problems. Here, he prefers the single-inlet fan.

Mr. Clarke, a graduate marine engineer from the University of Michigan, has had many years' experience in the heating, piping, and air conditioning field. He was recently appointed chairman of the Research Advisory Committee on Industrial Environment for the ASHRAE. As a regular contributor to Heating, Piping & Air Conditioning, he has authored articles on various aspects of design, operation, and maintenance of heating, ventilating, and air conditioning equipment and systems in industrial plants. Most recently he has written on the subject of industrial ventilation in the April through November 1958 and April and May 1959 issues. The latter two are on this subject of freeze protection.

BY JOHN H. CLARKE
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Air Conditioning and Power
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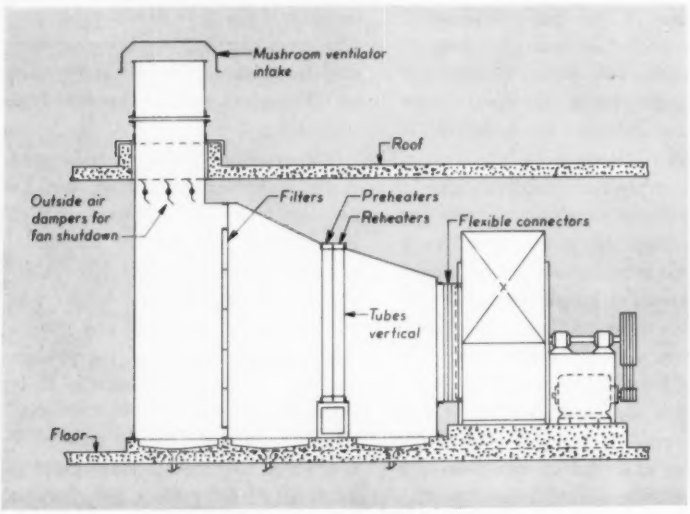
LAST WINTER was a rugged one for many parts of the country. Prolonged low temperatures brought to light a few problems of design which need to be considered if reliable operation of industrial ventilation systems is to be obtained.

Mushroom inlets, shown in Fig. 1, are desirable for the ventilation systems because they reduce wind pressure effect. But with such an arrangement it is difficult to turn the air into the system casing and maintain good flow through the air heaters. The same is true for wall inlets where a 90 deg turn is made into the system casing, as



1 MUSHROOM TYPE system inlets are desirable because they reduce wind pressure effect. But it is necessary to design intake so as to provide uniform flow to air heaters. This may require low inlet velocity, an orifice plate ahead of the filters' turning vanes. Where possible, filters should be set back far enough from inlet so as to permit them to act as orifice plates, thus providing uniform flow

in Fig. 2. With straight flow and 45 deg inlet louvers or shutoff dampers, the same uneven air distribution may occur. In each case the air filters will help to distribute the air if they are kept well back from the inlet and if the inlet velocities are low. High inlet velocities, 1000 fpm and over, may require more drastic correction.

Lack of uniform air flow, particularly with double inlet or multiple fan installations, can make it impossible for a control thermostat in the fan discharge to sense the temperature of the air leaving the air heaters. In some cases the cold air has stratified sufficiently to overload the lower part or one end of a heater section and cause freezing, even though the discharge temperature has appeared to be satisfactory. Such stratifying is a particularly difficult problem when the systems incorporate return air unless the air is thoroughly mixed.

Some engineers have incorrectly assumed that, where return air is provided in sufficient quantity to keep the mixture above freezing, they are amply safeguarded against heater freezing. Such is not the case. Serious heater damage occurred on a number of such systems last winter because of poor outside air-return air mixing. The use of minimum damper sections without heaters has caused this same trouble. However, minimum air heaters plug rapidly because the air is not filtered, and such heaters are another source of overheating in mild weather.

A few suggestions for providing uniform flow to the system heaters are:

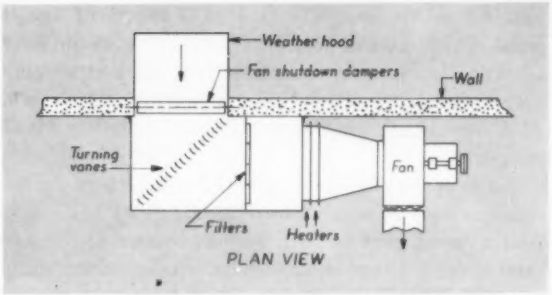
1) For 100 percent outside air systems where the incoming air makes a 90 deg turn into the casing (Fig. 1 or 2), either move the filter section back from the inlet and let it act as an orifice plate, provide an orifice plate in front of the filters, or provide turning vanes.

2) Outside air shutoff dampers which open to a maximum of 45 deg for weather protection in wall openings are tenable if the filter location and inlet velocity will permit even air flow. If not, it may be better to use fixed weather louvers at the wall opening, followed by shutoff dampers which open wide during normal operation. Where the system is arranged for outside and return air, either the dampers should be of the opposed type, as in Fig. 3, or else the dampers should rotate so as to force the two air streams to mix, as in Fig. 4. In the latter case an orifice plate may still be desirable to insure uniform flow over the filters and heaters.

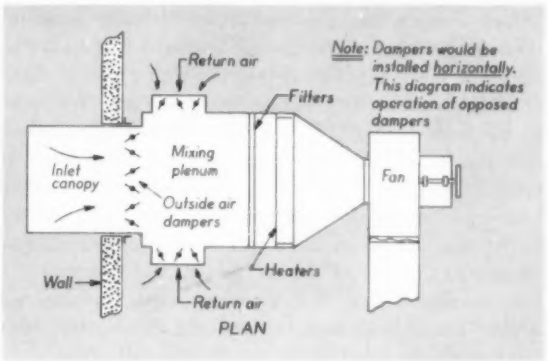
3) In lieu of minimum air dampers it is believed that the whole outside air damper section should be set to close to a minimum position, except on fan shutdown. Opposed dampers in conjunction with a weather canopy would be preferred to ordinary unidirectional dampers. This will provide much better air flow to the system.

4) Never lead outside air into a system casing below and parallel to return air. Under such circumstances cold air has been known to stratify all the way through the system casing and through a double-inlet fan to the discharge ductwork. This has been the cause of numerous freeze-ups.

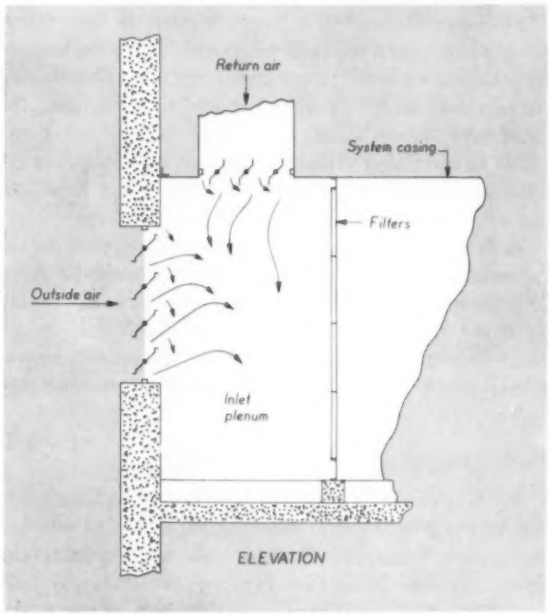
It was mentioned in the May issue that face and by-



2 WHERE INLET AIR to a system casing makes 90 deg turn from wall inlet, same design procedure should be followed as was recommended for mushroom inlet shown in Fig. 1



3 WHERE SYSTEM CASING handles outside air and area return air, opposed type dampers, arranged as shown, are most desirable to provide thorough mixing for uniform temperature and flow. Dampers are shown diagrammatically, for clarity. Normally, blades in outside dampers would be installed in horizontal position



4 WHERE OPPOSED TYPE outside air and return air dampers are not tenable, the unidirectional dampers should rotate open so as to force mixing of air streams. However, for uniform flow to air heaters, same recommendations as for Fig. 1 should be followed in design

pass control is frequently used as a safeguard against freezing. For such a control, a modulating steam valve, operating in conjunction with the face and bypass dampers, is usually arranged so that it will be wide open at 32 F outside air temperature. Further control is by the dampers.

But to permit the steam valve to be wide open, the face dampers must be nearly closed at 32 F. They will still be nearly closed, even at 20 F outside, because of the poor proportional volume control characteristics of the dampers. To improve the control many vendors of package units—and designers—have changed to opposed type dampers. This has helped solve one problem and created another.

Last winter a considerable number of heater freeze-ups occurred with face and bypass control installations because, at the nearly closed position with *opposed dampers*, high velocity air streams impinged on a few tubes of the heaters (Fig. 5). A number of engineers believe that this causes excessive condensation in the tubes affected, resulting in subcooling and freezing, despite the wide open steam valve serving the heater. It is also believed that a vacuum is created in the cold tubes, with respect to the rest of the air heater, and condensate is held in these tubes. If this occurs, rapid freezing will usually result. With *high velocity* cold air over the tubes, freezing would be expected.

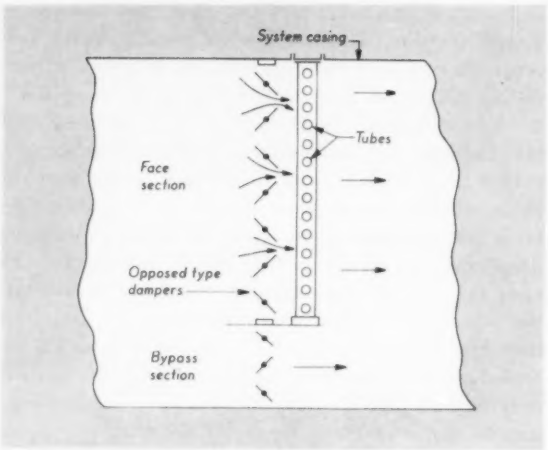
There are several answers to this problem:

1) Some engineers are reverting to the use of ordinary unidirectional dampers. However, these do not provide uniform flow over the heaters. It is believed that a better solution is to move the face dampers back far enough to prevent localized jet impingement.

2) Some manufacturers have relocated the face dampers to the downstream (following) side of the air heaters. This should solve the freezing problem but will make the temperature control problem more difficult from the standpoint of overheating.

3) Another suggestion has been to order air heaters with larger tubes. It appears that freeze-ups have not occurred where these have been used.

In face and bypass design, the use of a bypass section in the middle, between heater sections, should be given consideration. This will provide better flow to the fan inlet and will reduce stratification through double-inlet fans. The stratification caused by side or top bypass arrangements results in control and comfort problems.



5 OPPOSED TYPE DAMPERS, located too close to air heaters, have caused numerous freeze-ups with face and bypass control, despite wide open steam valves. Because steam valves are set to be wide open at freezing temperature, dampers will be nearly closed even at temperatures of 20 F outside. High velocity air jets coming through dampers and impinging upon tubes appear to freeze condensate as rapidly as it is formed. It is also believed by several engineers that a vacuum exists in such tubes with respect to rest of heater. Consequently, condensate is held in cold tubes. To avoid difficulty, dampers should be moved back from air heaters by about two damper widths at least. Some manufacturers have moved dampers to downstream side of heaters. Larger air heater tubes also appear to reduce possibility of freezing

Select, Install Air Heaters Carefully

Air heaters should be carefully selected and installed to minimize the problem of freezing, regardless of whether the system is designed for return air or all outside air. It is true that for air conditioning or similar systems where about 75 to 80 percent of the air is returned, the probability of freezing is remote.

Except for designs where the steam control valve is wide open so that the heater is under full steam pressure, the anti-freeze or inner distributing tube type of heater should be installed for the preheaters. Most engineers insist on such heaters, regardless of the type of steam control, for both preheaters and reheaters. But keep in mind that, while the inner distributing tube design reduces the possibility of freezing, it doesn't eliminate it. This was shown this last winter by the incidents mentioned.

The air heaters should be of the header type with the supply and condensate headers either at the same or opposite ends. Preferably, the heaters should be installed with the tubes vertical. This provides positive drainage, thus reducing the possibility of freezing. Many engineers prefer the double-header arrangement (steam and condensate at the same end), installed so that the steam is fed from the bottom. This assures good protection because the condensate drains back past the hot steam header. Others like the supply at the top and the drain at the bottom, as in Fig. 1. With this arrangement the gravity drainage is assisted by the flow of steam.

Either arrangement will give good protection against freezing. With the vertical tube arrangement, stratification through double-inlet or multiple fan equipment will be reduced or minimized. It is recommended that the tube lengths for vertical heaters not exceed 8 ft. Seven ft would be preferable. For large systems the heaters can be kept short by stacking them, one above the other, but offset to permit the steam and condensate connections.

It is sometimes necessary to install air heaters with tubes horizontal. Very few air handling units permit a

vertical arrangement. When installed horizontally the tubes should be pitched ¼ in. per ft for good drainage. Some manufacturers pitch the tubes within the heater casing. This is very desirable because it is sometimes difficult for contractors to provide proper pitch on the job. Such pitch causes difficulty with both the piping and the sheet metal attachments to the heater flanges.

Horizontal heaters should also be restricted in length to reduce the freezing and stratification problems. The recommended maximum length is 7 ft, but 6 ft is preferred. Heaters of the double-header type (steam and condensate at the same end), installed end-to-end, should be used for large systems or wide package units requiring large heating surfaces. This will also help reduce the stratification problem. For smaller size installations, heaters with either double-headers or headers at opposite ends may be used safely if properly installed for drainage. Every installation should be checked carefully.

It is very important that the heaters be sized correctly. Oversizing will cause hunting, and the heater will be lightly loaded at freezing temperatures. Both conditions make the heater vulnerable to freezing. In addition, overheating will also be a problem. A heater that is lightly loaded may condense the steam and subcool the condensate so rapidly during freezing conditions that the drops of condensate will freeze as fast as they are formed. So size the preheater and reheater for full load conditions, without a safety factor other than a 10 percent dirty tube factor.

A single-row preheater should be used because it will be well loaded at 32 F outside temperature. A two-row heater will not be sufficiently loaded except where only 3 or 4 fins per in. are used on the tubes. But a two-row preheater has another drawback. It is not unlike installing two heaters in series on the same control valve. It is well known that a series arrangement is very vulnerable to freezing. Air heaters are condensers and they are diabolical in the way in which they may load up as the steam load increases. It could be either the first or the second row of a two-row heater. If the second row takes the load, the first row will be very likely to freeze at air temperatures below 32 F. So design for safety and use single-row preheaters for any systems handling supply air at temperatures below freezing, particularly where modulating steam control is used.

Leaving Temperature Should Be Above Freezing

Select the preheaters for a temperature rise which will result in a leaving temperature above freezing when the outside air is at the base temperature for design. In this way you can be sure that the tube surface and condensate inside are definitely above freezing temperature. The reheaters for the systems can be single- or double-row as necessary to carry the required additional heating or tempering load.

The face velocities selected by most designers are around 600 fpm. This is the recommended velocity for low pressure steam and 100 percent outside air where the inlet temperatures may be −10 to −20 F. Higher face velocities are quite tenable, particularly with higher pressure steam. But in such cases, it is wise to check to be sure that the steam capacities of the heater tubes and orifices are not being exceeded. Proceed with caution for such installations.

Prefer Single-Inlet Fan

Fans are not directly involved in freeze protection, but their selection does play a part in the problems of stratification and control. To minimize the problems, a single-inlet fan is always preferable. Where double-inlet fans are used, precautions should be taken in the design of the ductwork and the selection and installation of the heaters as previously mentioned to reduce stratification.

Control thermostat locations must be such that the thermostats will be able to measure the actual mixed air temperature. Where package type handling units are installed, a single fan unit is the most desirable because it is easier to work out the problems of control and stratification than for multi-fan units.

Some Operation and Maintenance Tips

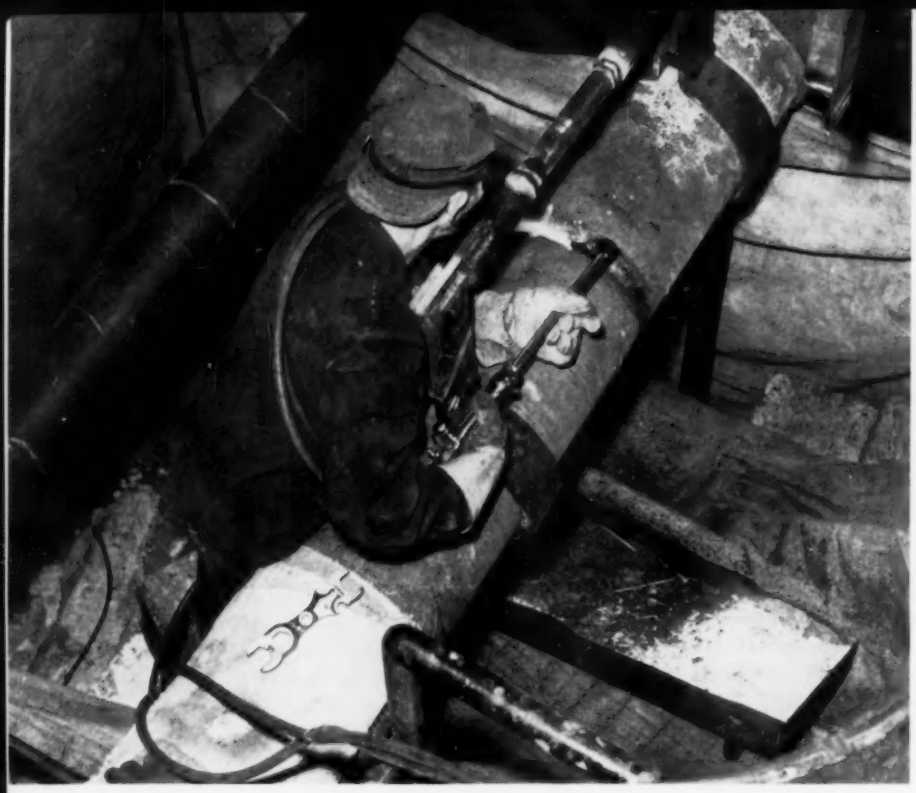
Aside from the routine maintenance which should be provided for all of these systems, there are several items which are particularly important from the standpoint of freeze protection. These are as follows:

1) When systems are started during cold weather, always check to be sure that the steam valves are operating and that the air heaters are warm. With normally open valves and the usual control arrangement, this should be the case. But it pays to be sure. Open the control bypass valves if necessary, to assure warm heaters. This will minimize expansion stresses as well as the possibility of freezing, and will also reduce the initial condensate load and the possibility of tube rupture from water hammer.

2) At the start of the heating season, thoroughly check each system to be sure that the piping and strainers are clear and that the control valves and steam traps are working properly.

3) Keep the air filters in good condition. If they are excessively plugged, the system volume may be drastically reduced. This has the same effect as oversizing the heaters. Consequently, the small amount of steam admitted by modulating control systems may condense rapidly and freeze. Control hunting may also result and thereby cause freezing.

4) The system traps and strainers should be inspected and cleaned on a routine schedule. On new systems they should be checked weekly until a longer interval is indicated by the amount of pipe dope and sludge found in the piping and strainers. It is suggested that at least a monthly schedule of checking and cleaning should be maintained for the traps and strainers for the first year of operation. Pipelines should be reasonably free of pipe dope, but from a practicable standpoint this type of workmanship is seldom obtained. ∓



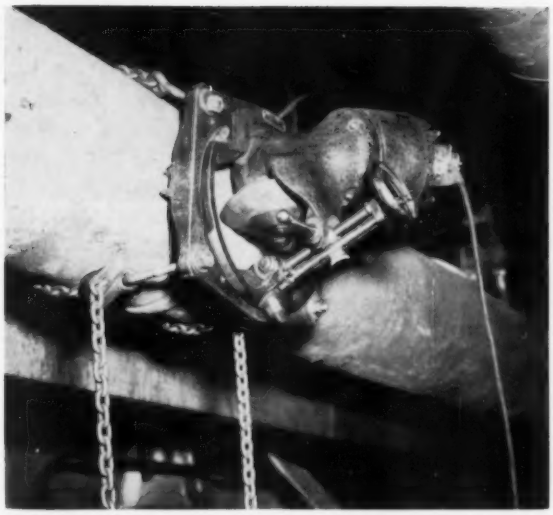
BY FLAME GOUGING, welded joint can be rewelded without opening steam line. Entire joint is heat treated at 1700 F for 2 hr and slow cooled after rewelding

Carbon Steel Has Its Problems, Too; When Piping Steam at 800 F

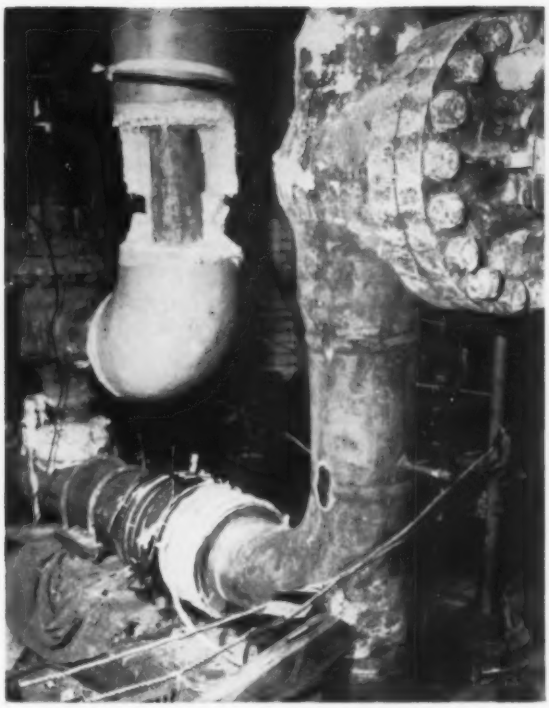
Graphite formation isn't limited to carbon-moly material. It can occur in carbon steel piping as well — and even at lower operating temperatures

• Although the literature contains many references concerning the problem of graphitization of carbon-molybdenum steel steam piping materials, the same problem also occurs in carbon steels in which severe cases of graphitization have been found at 800 F. In sampling carbon steel piping to determine its graphitized condition, other significant findings have been made, such as cracking of internal surfaces at desuperheaters, flow meters, and drain connections. A general discussion and illustrations of these problems are given in this article.

Prior to his assignment to his present post just last year, the author was research engineer and assistant supervisor of the Chemical and Metallurgical Div. of Detroit Edison's engineering research laboratory. A metallurgical engineer, he is a member of various ASTM and ASME committees dealing with materials.



WELD PROBER shown in position for removal of samples from steam line



REHABILITATION is in progress on a carbon steel manifold. Joints in foreground have been sampled. Joint at bottom is covered with coils and is insulated for induction heat treatment

BY I. A. ROHRIG
Materials Engineer
Generation Div.
General Engineering Dept.
The Detroit Edison Co.

SINCE THE FAILURE, in January 1943, of a welded joint in a high pressure, high temperature steam line at the Springdale Station of the West Penn Power Co., failures at welded joints have occurred in two other plants, one in 1948 and the other in 1957. The plant in which the failure occurred in 1957 had two such welded joint failures within a two-week period resulting in a complete shutdown of the plant.

In these three plants the operating temperatures varied from 900 to 935 F at pressures ranging from 650 to 1325 psi. The piping in which the failures occurred was, in every case, carbon-molybdenum steel.

So much has been written and said about graphitization in carbon-molybdenum steel that the impression may have been created that the problem occurs solely in this material. The purpose of this discussion is to show that graphitization occurs also in carbon steel piping, and that it can occur in such piping to a harmful degree at 800 F, or approximately 100 F lower than in carbon-moly steel. No failures have occurred in carbon steel piping. But that should not mean that carbon steel is immune to potential failure due to graphitization at welded joints.

Search for Graphitization Bares Other Problems

Aside from graphitization at welded joints, other significant problems have occurred also in carbon steel piping materials—problems that have come to light somewhat as a result of the attention that has been given to piping in a search for graphitization.

In general, the investigation begins and usually relies on the conventional weld prober type of sample. However, this procedure should be augmented by occasional removal of an entire joint or section of piping for complete tests and evaluation of the material.

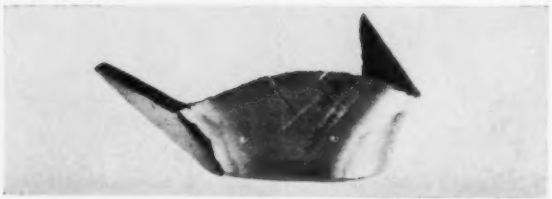
Fig. 1 on the next page shows a weld prober type of sample removed from a welded joint. This type of sample provides adequate material for both a metallographic examination and a bend test. Both tests are advisable. The condition of the heat-affected zone with respect to graphite formation can be evaluated quite well by a metallographic examination. However, a bend test should always be used because it provides conclusive data regarding the ductility of the material both with respect to graphitization and possible structural defects. This will be discussed later, with particular reference to castings.

Fig. 2 shows a bend test strip cut from a weld prober sample. The particular joint represented by the sample was acutely graphitized at one side only, as illustrated by the brittle fracture that occurred at the left hand side of the bend strip.

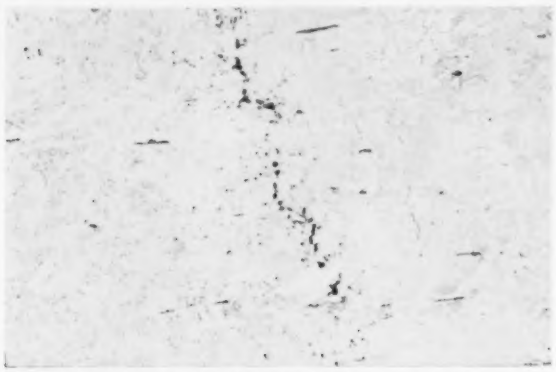
Figs. 3 and 4 are photomicrographs of the graphitized zone in the weld heat-affected zone of a joint in carbon steel after approximately 91,000 hr of steam service at 810 F and 600 psi.

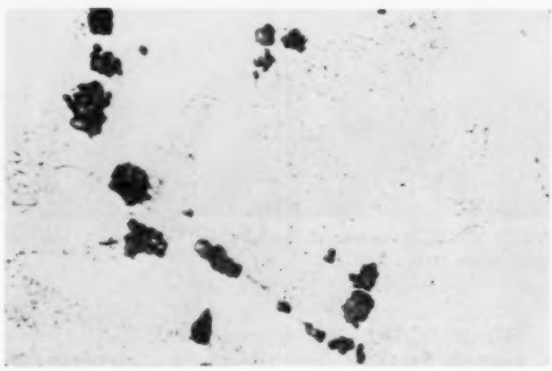
Fig. 5 shows bend test strips cut from weld prober samples taken from the same welded joint for which the graphite is shown in Fig. 3. This was a valve-to-pipe joint. The bend test samples showed very low ductility,

1 TYPICAL WELD PROBER type of sample has been removed from a welded joint for examination and testing



2 THIS STRIP, cut from weld prober sample, has failed bend test. Note brittle fracture

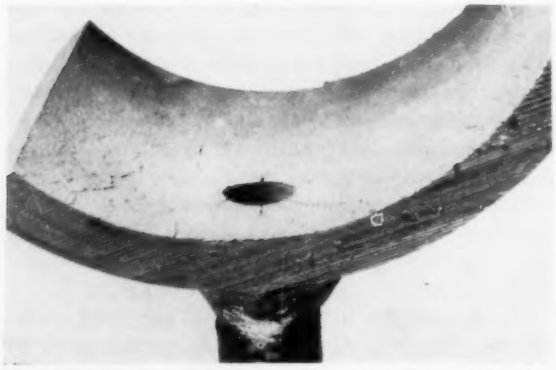




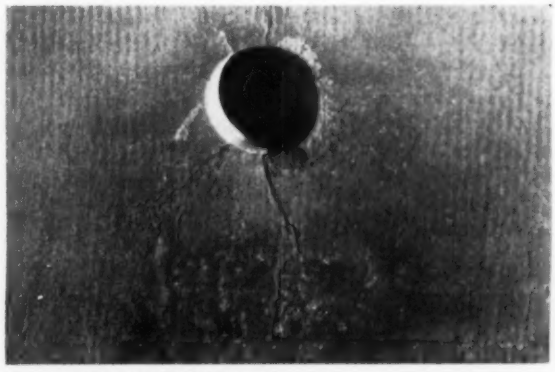
3-4 PHOTOMICROGRAPHS REVEAL graphite formation in weld heat-affected zone of joint in carbon steel in service at 810 F. Fig. 3, left, is magnified 100X; Fig. 4, right, is same sample magnified 1000X

5 VALVE-TO-PIPE joint bend test strips showed very low ductility. Bottom section illustrates condition when sampled; top section has undergone heat treatment

6 MANY VALVE CASTINGS sampled showed low ductility and cracked readily. Note small crack, which is at valve side of valve-to-pipe sample



7 CORROSION FATIGUE cracks at a drain connection shown here. This is usually manifested by system leakage



8 CRACKS ON INSIDE surface of steam main at flow meter connection are further indication of corrosion fatigue

due both to graphite on the pipe side of the joint and to casting defects at the valve side. The valve was chrome-nickel-moly alloy steel and for that reason was immune to graphitization. The remedy applied to recondition this joint was to flame-gouge the graphitized area of the pipe side of the joint. It was then rewelded and the entire joint heat treated at 1700 F for 2 hr followed by slow cooling which treatment reconstituted the weld heat-affected zones in which severe graphitization occurs and also produced desirable ductility in the cast metal at the valve side of the joint.

Find Low Ductility in Valve Castings

Although the weld sampling was done primarily to determine the graphitized condition of the piping, it was found that many of the valve castings showed low ductility and cracked readily in the small weld prober samples. Fig. 6 shows a small crack found at the valve side of a sample. Whenever cracks were found in the valve metal, those areas were ground out and rewelded at the same time that repairs required by graphitization were made at the pipe side of such joints.

It was a fortunate circumstance that the author's company had selected alloy steel cast valves for service at 800 F because, as mentioned previously, the chromium-nickel-molybdenum alloy material does not graphitize. This is true also of chromium-molybdenum materials. If the valves had been made of carbon steel, as was the pipe, then it is very likely that graphitization would have occurred in the valve castings also.

Some investigators have reported finding gross and harmful casting defects in valves that were sampled during a graphitization exploratory program. In the author's company, only small cracks have been found at valve ends and in several instances larger cracks elsewhere in castings. In all cases, the cracks have been ground out and rewelded in place. Suitable preheat and local stress-relief have been applied to such repairs of castings. Initially, such repairs on valves were approached with hesitance because it was thought that warping of valve seats might occur. Weld repairs and heat treatment of valve ends at 1700 to 1750 F have resulted in no warping problems in over 50 valves made of chromium-nickel-molybdenum and carbon-molybdenum alloy steel in sizes of 10 and 12 in.

Must Sample All Pipe Sizes

Although most examples of dangerous graphitization have occurred in piping of sizes 10, 12, and 14 in. and larger, in the author's experience very serious graphite formation has also been found in pipe of 6 in. diam and a few significant indications have been seen in 1 in. diam drain and bypass connections on valves. Serious graphitization has also been reported in superheater tubes. In a program of examination it is advisable to include samples from pipe and tubing of all sizes made of materials susceptible to graphitization, namely carbon-molybdenum and carbon steel, that are operating in a temperature range in which graphite formation can occur.

In the article *Weld Probe Sampling Programs of Graphitized Piping Are Still Your Best Guarantee of Safety of Carbon-Molybdenum Steel Steam Piping Systems*, by Helmut Thielsch, in the March issue, excellent treatment is given the subject of critical formation of graphite and the number of samples to be removed in order to properly evaluate a piping system. In general, as Mr. Thielsch states, samples should be removed from 30 to 50 percent of the joints; one sample per joint is sufficient. The literature contains numerous references on the subject of graphitization. Although most references cover carbon-molybdenum piping, the same rules apply to carbon steel.

Corrosion, Fatigue Stress Cause ID Cracking

A further interesting and important finding that was revealed during graphitization sampling was that cracking was occurring at the inside diameter of steam piping at water flow connections, in desuperheater areas, and at drain connections. The cracks are due to a combination of two actions occurring at the same time, namely, corrosion attack and fatigue stress. Moisture droplets that are sprayed on the hot surface of the pipe (as for example by a desuperheater spray, or moisture droplets at drains, or condensate flushed in by the action of flow meters) leads to such cracking. The metal surface expands due to heat and then contracts alternately as the moisture strikes the surface.

Fig. 7 is an illustration of corrosion fatigue cracking at a drain connection in a steam line. Usually the first indication of corrosion fatigue cracking is manifested by a leak. By that time, however, the pipe section is honey-combed with cracks and is beyond repair and must be replaced.

Fig. 8 shows cracks on the inside surface of a steam main at a flow meter connection. This is a further indication of corrosion fatigue cracking and resulted in replacement of the affected section of pipe. Similar cracks have been found at numerous flow meter connections, but were detected before leaking occurred.

If cracking is not too extensive, suitable repair can be made by strengthening the pipe by means of a welded pad on the outside and revising the flow meter piping so as to preheat the incoming condensate. Corrosion fatigue cracking has also been reported in the vicinity of feedwater connections in boiler drums.

The purpose of this brief review, therefore, is to point out that, although a piping system may appear to be in satisfactory condition and safe for operation, sampling of sections of the piping may reveal conditions that are not only harmful but which, if allowed to persist, may result in such detrimental effects that replacement may ultimately be necessary. By sampling and examination of selected sections, suitable repairs can be made in time and the system maintained in safe condition for many years of operation. ≠

WORLD'S LARGEST air conditioned building is the Pentagon in Washington

U.S. Government Study Proves Air Conditioning Boosts Work Output

A five-month study during the summer of 1957 by the Office of Buildings Management, General Services Administration, in cooperation with another Government agency, indicates that the work output of employees in an air conditioned space is greater, on an average, by more than 9 percent than that of employees in a similar space which is not air conditioned.

NOW THAT AIR CONDITIONING has come to be regarded as a necessity by the public in general, building owners find themselves in the position of being forced to provide air conditioned space in order to hold their tenants.

Industry, searching for some way to justify the great expense of air conditioning, has tried to find proof that it increases both work production and accuracy, and that there is less absenteeism. If such proof could be established, it would be possible to calculate the benefits of air conditioning in terms of dollars and cents, and to determine over what period of time the system would pay for itself through savings in employee salaries.

Numerous reports have appeared in technical papers, giving accounts of tests in which air conditioning is said to have increased productivity as much as 50 percent, but when these reports are more carefully analyzed it is generally found that other envirnomental changes (such as painting, providing higher light intensity and acousti-

This report (Research Div. Technical Bulletin PBR-161, released by the Office of the Assistant Commissioner for Buildings Management, Public Buildings Service, General Services Administration) is published herein in its entirety by Heating, Piping & Air Conditioning as being of pertinent interest to its readers.

"Air conditioning resulted in:

- ***"substantial average increase in work production***
- ***"slight decrease in errors***
- ***"measurable decreases in absenteeism and employee's living expenses***
- ***"an important contribution to employee comfort and morale."***

cal treatment, etc.) were made at the same time air conditioning was installed. It is, therefore, considered fallacious to credit air conditioning with all the claimed benefits. This reasoning is in accord with the Hawthorne Report (published in 1927, and based upon exhaustive research) which showed, surprising as it might seem, that *any* change in working conditions, whether for better or worse, results in increased work production for at least a time.

Because of the role the General Services Administration plays as Government landlord (we are responsible for maintaining and operating some 74 million sq ft of Government-owned space housing Government activities), we share industry's anxiety to know the measurable benefits of air conditioning on work production, accuracy, and absenteeism.

Despite the great number of buildings under our supervision and the wide variety of work performed in them, we were, until recently, unable to find an activity suitable for testing the effects of air conditioning—one in which the same work is performed year after year, and where employee work output can be evaluated with some degree of accuracy.

Late in 1955, however, we found an operation in one of the Government departments which we believed filled these requirements. The work performed there has not varied through the years. It consists of making great numbers of so-called "searches" (more than 100,000 each month), and each employee must complete a minimum quota.

The department not only gave consent to the test, but cooperated to the fullest by collecting the extensive data required.

Selection of Test and Control Areas

The building in which the test was conducted is a wing type structure, with the head house in the center. The wings were of open construction, without definite corridors.

The west wing was selected as the test area, and the center wing as the control area. Both were principally occupied by file cabinets where the searches are performed.

All space was heated by direct radiation from radiators under the windows. Ventilation depended on opening the windows, which had all the usual disadvantages.

The lighting intensity was 4.3 watts per sq ft, furnished by 500 watt semi-indirect incandescent luminaires. The walls were painted "Government buff."

Original Test Plans and Objectives

Originally it was planned to make a threefold study:

1) It was intended to study for a two-year period the effect of air conditioning on production. Only insignificant environmental changes were to be made in the test and control areas during this phase of the study.

2) On completion of this two-year study it was planned to install "high intensity" lighting of about 100 footcandles in the test area, and to evaluate the additional effect.

3) Following the second phase of the study, it was intended to change the environmental colors in the test area and study this effect.

Revised (Final) Test Plan

When bids on the original plan were received, they exceeded available funds by a wide margin. Therefore parts two and three of the three-phase study were abandoned. Under the revised plan, existing lighting and painting conditions in both areas were changed. Identical painting and lighting were provided so that, with the exception of air conditioning in the test area, all employees would be working under the same conditions.

The walls were painted a flat light green, and the ceilings flat white. The lighting fixtures were changed from semi-indirect incandescent to semi-indirect fluorescent.

Air Conditioning System

The air conditioning system installed for the test area was operated to hold a uniform temperature of 75 F ($\pm$ 2 F) and a relative humidity of not in excess of 50 percent.

The cooled and dehumidified primary (outside) air was supplied by an overhead supply duct, running approximately the full length of the wing, with a sidewall outlet per bay discharging toward the windows.

The sensible cooling or heating was accomplished by fan-coil units located under each window. These units were supplied with chilled or hot water, depending on the season. The east and west sides of the test area were controlled in groups by thermostats located near the center of the wing, while the radiators in the control area were

hand controlled. The amount of outdoor air supplied to the test area was 3800 cfm (0.23 cfm per sq ft).

Selection of Work Groups

To assure a true comparison between the effects of air conditioning on the productivity of the two test groups, only employees who were thoroughly experienced were selected to work on these test teams.

Each of the participating teams consisted of 70 persons, or 140 in all. The average age of the employees working in the air conditioned area was 21.25 years, varying between 18 and 33, while the average age of those in the non-air conditioned space was 21.51 years, ranging between 19 and 32. An equal number of men and women participated on each team.

The testing period covered five months (May through September 1957). During this time, due to marriage, military leave, promotions, reassignments, etc., the average number of employees in the test area dropped from 70 to 62.6, and in the control area to 62.2.

Work Done by Participating Organizations

The Office of Buildings Management, which is responsible for operating and maintaining the building, undertook the general coordination of the project and furnished the engineering, installed the new luminaires, and painted the areas.

The occupying agency collected the statistics on work rates, number of errors, and absenteeism.

Results of Study

A. Increased Work Production:

Does air conditioning increase work production? The answer to this most important question definitely is "yes."

How much is the increase? On this point the study was not completely conclusive. Buildings Management had hoped to continue this test for at least two years, which would have been long enough to reveal an accurate measurement of the increased production. But since performance of the particular task involved in this test serves as a stepping stone for the advancement of the employees, there is a considerably greater than average turnover of personnel. As noted earlier, the number of employees participating dropped from 140 to 124.8 in the five-month test period, due to reassignments, marriages, etc. At this rate, the test and control groups would soon have dwindled to the point where the study would have become meaningless.

The records for the five-month test period show that the work production of the group in the air conditioned space varied all the way from 6.5 percent to 13.5 percent higher than that of the employees in the control area. Weather Bureau data for the period furnished no definite clues to this varied production curve. Neither could the occupying agency pinpoint the reason for this variation.

It is known to the agency, however, that this difference is typical of employees working on this assignment, as it had been observed for many years that such employees' production varied from month to month by a few percent. The difference in time required to complete a search can vary a great deal, depending upon the case — one search may take hours, and another only a few minutes. Generally the total number of completed searches averages out the same from month to month.

In the light of these observations it would seem logical that the employee's outside activities, which are a recognized factor in work production, were probably largely responsible for the variation in production.

Despite the "unknowns" in this study, the 9.5 percent average production increase in the air conditioned test area over the rate of production in the non-air condi-

GSA is responsible for maintaining and operating some 74 million sq ft of Government-owned space housing Government facilities

tioned control area is very significant. Frankly, it exceeded our fondest expectations. We know, from our previous studies, that a seven-minute saving in time per employee per day will more than pay for the expense of an air conditioning system. In other words, if work production increases only 1.5 percent per year, the system will pay for itself through savings in salaries. We feel certain that the increase in production will never drop below this value.

During the test period the best work production in the non-air conditioned area occurred in June and September; in the air conditioned area production was highest in June, July, and September. The low point in the air conditioned space was in August, and probably was related to the outside weather (which was hot and humid) to which the employees were subjected during off-duty hours. If it were possible to run a test under controlled laboratory conditions, the reason for these differences in productivity might be found.

B. Decrease in Errors:

In some months more errors were made in the air conditioned area than in the non-air conditioned. There was an average 0.9 percent increase in errors per person per month in the control area — a figure which is for all practical purposes identical with the average in the test area and does not permit reaching any definite conclusions. In this particular operation, accuracy is more important than production. If an employee has an abnormal number of errors per year he is reassigned to less exacting duties, so it is safe to assume that all employees keep their errors to a minimum and that the percentage of errors, regardless of working conditions, is fairly constant.

C. Decrease in Absenteeism:

Accurate records were kept of all sick leave taken and its causes. All absences positively not associated in any way with air conditioning or the lack of it (fractured bones, operations, abcesses, skin rashes, bronchitis, etc.) were disregarded for purposes of this survey. This left only minor ailments such as headaches, upset stomach, etc., to be considered. While we suggest that no definite conclusions be drawn from this test, it is interesting to note that in the non-air conditioned area the absenteeism was 2.5 percent higher than in the air conditioned space. This is the more astounding considering that the groups mixed with each other and strangers at lunch time, rest periods, in stores, on streets, and in public conveyances for the major portion of the day, and therefore were exposed to all kinds of diseases prevailing in the community.

D. Intangible Effects:

It was interesting to talk to people in the air conditioned area and hear their reasons for liking to work there. All employees, with the exception of one girl, preferred to work in the air conditioned space and hoped they would not be transferred out of it.

The most important reasons for this preference, from their point of view, are listed below. No attempt has been made to list them in the order of their importance.

1) Considerably less consumption of chilled drinking water. (This is a factor which may be worthwhile for Buildings Management to pursue further, since a number of the buildings under our control have a population of over 10,000, and some as high as 30,000. A small saving in drinking water per person might mean a considerable saving in installation and operating costs.)

2) The girls were pleased with the noticeable saving in money on "makeup" and "hairdos," attributed to the absence of electric fans and relief from the high humidity which prevails in Washington. It not only saved them money, it boosted their morale to know they still looked their best at the end of a busy day. The money saved was a very important item to these employees.

3) Elimination of wall fans was appreciated by employees for still another reason. No matter where fans used to be placed, there was always disagreement among the employees about where they should be located, and there were complaints about the noise and the blowing of papers on the cabinets.

4) Less soiling of clothing. All employees, both male and female, agreed that their clothing remained cleaner and fresher, and showed less staining due to perspiration and discoloration due to dirt. Many felt they could wear their day clothing to a social function that same night.

5) The majority felt that the heat after working hours did not affect them as much as formerly, when they were subjected to it all day.

Conclusions

On the basis of the evidence, it would seem fair to conclude that the air conditioning resulted in:

1) A substantial average increase in work production (9.5 percent).

2) A slight decrease in errors (0.9 percent).

3) A measurable decrease in absenteeism (2.5 percent).

4) A measurable decrease in employee's living expenses (savings on cleaning bills, hairdos, makeup, etc.).

5) An important contribution to employee comfort and morale.

It is safe to assume that in any other type of office work, where the rate of production is not standardized, or where no minimum requirement must be met consistently, the increase in productivity will be more than enough to pay for air conditioning through savings in employee salaries.

We feel sure that despite other changes in environment made at the time air conditioning was installed (such as a new paint job and new lighting), the air conditioning should be given most, if not all, the credit for the increased work production.

The Office of Buildings Management hopes to continue this study to learn what other factors contribute to an increase in human efficiency. ⧺

Temperature Drop Is an Important In Choosing Most Economical

Low, intermediate, and high temperature hot water heating system operating temperatures and design temperature drops have definite bearing on the selection of the most economical design for each application, according to G. F. Carlson, Bell & Gossett Co., speaking at a conference in Milwaukee recently. In an article in the May issue, his discussion of the low and intermediate temperature systems was presented. Here, he talks about the high temperature hot water system, stressing the critical importance of excellent temperature-pressure control.

SPEAKING BEFORE a recent heating, air conditioning, and refrigeration conference at Marquette University, G. F. Carlson, Bell & Gossett Co., stated that there are three general classifications of hot water heating systems and that their differences lay primarily in their operating temperatures and design temperature drops.

After discussing the relative considerations for the low temperature and intermediate temperature hot water systems (May, pp. 106-109), Mr. Carlson turned to the high temperature hot water system, stressing the importance of excellent temperature-pressure control to successful operation.

Temperature-pressure control is one of the more important facets of HTHW design, according to Mr. Carlson, because, in the range of 400 F, each degree rise in temperature requires about 3 psi increase in pressure to prevent boiling. More than this, as temperatures are increased beyond 400 F, the required rate of pressure increase to prevent boiling goes up rapidly. The problem of temperature-pressure control for the HTHW system is therefore much more critical than for lower temperature systems.

Specific temperature-pressure control arrangements for the HTHW system are many and varied. Mr. Carlson broke these down into three general classifications:

1) The steam drum system.
2) The constant pressure system.
3) The variable pressure (compression) tank system.

Each particular pressurization method has its advocates. Each will provide adequate pressurization — if careful analysis is made of the interaction of all system variables on pressure control, he said.

Steam drum pressurization is the oldest and probably the most common method used for HTHW pressurization. A rudimentary one-pump steam drum system is illustrated in Fig. 1. The steam drum is of sufficient size to store expanded water and to allow steam space. Boiler water is circulated within the drum and allowed to steam at saturation pressure. This pressure is exerted as static pressure on the system.

The drum is usually mounted high to provide insurance against pump cavitation. Pump "net positive suction head" (NPSH) requirements may determine tank height and become a design factor for the steam drum system since operation is always close to the boiling point. In order to provide an additional anti-cavitation safety factor, it is usual practice to mix return water with steam

Design Yardstick

Hot Water Heating System

drum supply water so as to reduce water temperatures entering the pump suction. Another reason for high tank mounting is ease of establishing and maintaining steam space. This consideration is important on high static height systems.

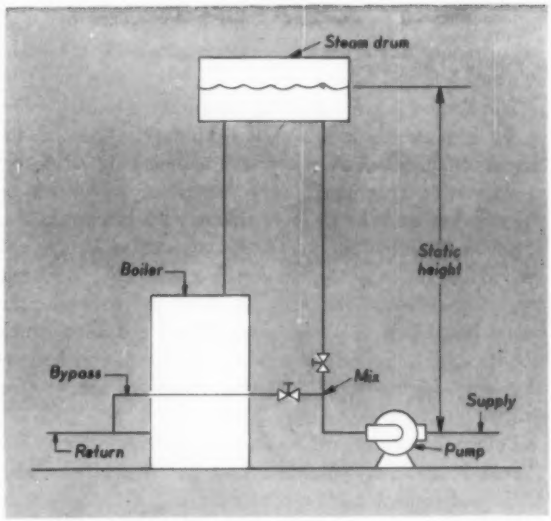
It is important that water drawn from the drum be at a temperature corresponding to the steam pressure exerted in the drum. Thorough analysis must consequently be made of water mixing arrangements in the tank. Short circuiting of very high temperature boiler water directly through the tank and out to the system must be avoided.

Quick acting pressure sensitive controls in the steam chamber of the drum energize basic system firing controls. Boiler heat input must be immediately responsive to changing steam drum pressures. If boiler response is slow, cold return water, due to sudden increased load, could enter the tank and reduce pressure below saturation pressure of hot water out in the system. System flash of water to steam will cause loss of steam space in the drum and consequent water hammer.

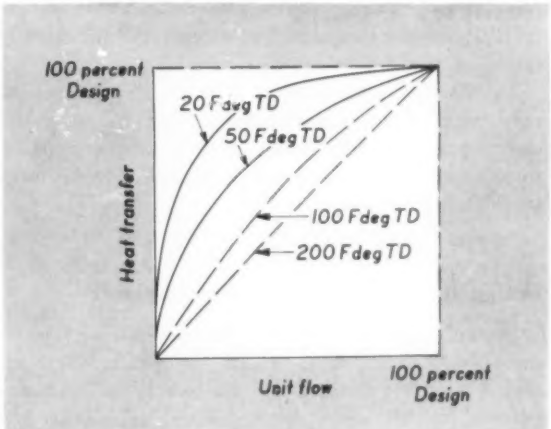
Mixing of return water with steam drum supply water helps provide against this occurrence because system water temperatures are reduced. The mixing point is often specially designed to provide through mixing. Mr. Carlson pointed out that, as loads are reduced, system return water temperatures approach supply water temperatures; and, unless ratios of drum supply water to return water are modified with load changes, the desired temperature reduction may not be obtained.

It is important on forced circulation water tube type boilers — the type most used on HTHW systems — that flow rates through the boiler meet manufacturers' requirements at all times, he stated. Burned out tubes or loss of heating ability due to steam flash in the tubes at a crucial temperature-pressure control moment can result from low flows. Unless guarded against, low boiler flow rates can occur due to system control valve close-off at low loads or because of attempts to decrease the boiler steam drum supply water to return water ratios as the load decreases. Separate boiler circulation and system circulation pumps help overcome this problem.

The HTHW steam drum system must be very carefully analyzed because the system always operates close to the



1 STEAM DRUM is common method used for HTHW pressurization. Steam drum is big enough to store expanded water, allow steam space. Boiler water is circulated within drum, allowed to steam at saturation pressure. This pressure is exerted as static pressure on system



2 HEAT TRANSFER ability of hot water heating system is related to unit flow as shown above. Water flow balance requirements increase with increased design temperature drops

"engineer should select the most desirable combination of design temperature drop and operating temperature"

boiling point. Mr. Carlson stressed that the engineer must take into careful account all variables affecting temperature-pressure control. The system temperature-pressure control design should be an integrated effort by the engineer and specialists concerned with the boiler, the controls, system heat exchange, and the pumps — taking into account response times, changing loads, flow rates, etc.

Following design and installation, competent operating personnel must be employed.

The constant pressure HTHW system tank can be pressurized by steam from a separate heat source or by nitrogen. Considerations of required tank size and re-use of nitrogen often lead to modifications of the basic scheme.

The system is controlled by temperature sensitive controls. Because these controls exhibit "lag" time, the amount of pressurization over the boiling point at design temperatures becomes a very important consideration. Control lag and boiler over-ride considerations are of importance since, after careful study, these factors can be reduced to expected temperature over-ride. Temperature over-ride can then be converted to required pressurization. Since 1 F deg of temperature change equals about 3 psi (or greater) pressure change, it can be seen that very high system operating pressures may be required.

Boiler flow rates are again of great importance and should be carefully analyzed as a function of changing loads and control valve settings, he said.

HTHW systems are also designed using compression tanks. Compression tank sizing is extremely critical because of the variation in system water volume due to load changes. The fact that total system water volume will normally be reduced as load increases must be taken into account. Very careful evaluation of the overall temperature-pressure control problem must be made. As with all HTHW systems, competent operating personnel must be employed.

The 200 F deg temperature drop HTHW system naturally requires greatly increased design and operating care, compared with lower temperature systems, if trouble-free temperature-pressure control is to be maintained, he pointed out.

Design in Terms of Water Flow Balance

System design in terms of water flow balance becomes increasingly important as design temperature drops and design operating temperatures are increased. Water flow balance for hot water systems is determined by heat transfer balance needs, by response time for various circuits under intermittent circulation conditions, and by "air control" requirements.

It should be remembered, he said, that the hot water heating system is a comfort producing heat transfer machine and that, in terms of overall building heat balance, we are interested in water flow balance only to the extent that heat transfer balance is affected. The hot water system is not necessarily a water metering device. Water flows for the 20 F deg drop system can be appreciably different from theoretically required flows without greatly affecting heat transfer. Water flow balance requirements increase with increased design temperature drops. This can be concluded by comparing the change in overall heat transfer caused by changes in water flow for the 20 F deg and 50 F deg temperature drop systems. Such a comparison chart was presented by Mr. Carlson as Fig. 2.

For any specific water-to-air heat transfer unit, similar charts can be developed by observing the following relationship:

Btu per hr loss by water = Btu per hr coil heat loss

or:

Lb per hr (water flow) $\times$ ΔT (water temperature drop) = $UA\ \Delta T$ (temperature difference, air-to-water)

where:

$$U = 1/[(1/h_1) + (1/h_2)]$$

and:

h_1 = water side coefficient of heat transfer (variable, depending on water flow)
h_2 = air side coefficient of heat transfer.

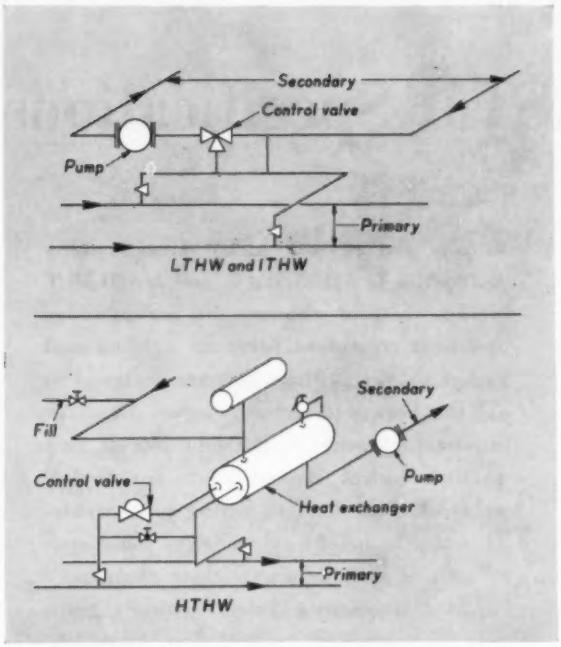
The chart illustrates that, at 50 percent of theoretically required flow for the 20 F deg drop system, actual heat transfer has decreased less than 10 percent. The 50 F deg drop system, on the other hand, will register a change of 10 percent in heat transfer for a smaller flow change. Mr. Carlson drew several general conclusions from this chart:

1) Heat transfer is more affected by flow change for the 50 F deg than for the 20 F deg temperature drop system.

2) The engineer has more latitude in terms of pump selection for the 20 F deg drop system than for the 50. The difference is in degree only, however, since the 50 F deg drop system also allows considerable overall flow change variation without appreciably affecting heat transfer.

3) The common practice of oversizing pumps to provide a "safety factor" is not necessary for either system. Increasing flow rates beyond theoretical design does not add appreciably to Btu per hr output. Heat transfer ability is not increased by oversizing the pump to any important degree.

4) It is not necessary to balance water flow in either system to extremely precise theoretical flows. In general, these systems, if properly pipe size balanced, will not need



3 SECONDARY INDIVIDUAL building control arrangements may vary, depending on design temperatures. Since standard equipment is usually adequate for LTHW and ITHW systems, primary-secondary control arrangements can be used

mechanical flow adjustment. If mechanical adjustment is needed, square headed cocks will provide the necessary range of adjustment.

Larger hot water systems are almost always continuously circulated because of the problem of system response time. In addition to continuous circulation, modulation of water temperature with changes in outdoor temperature is common. This combination provides fast system response and extremely sensitive control for the LTHW system.

The 100 F deg drop ITHW and 200 F deg drop HTHW systems' heat transfer-flow curves were plotted by Mr. Carlson against the LTHW curves. He noted that the 100 F deg drop system requires a small water flow change to change heat transfer 10 percent. The piping system must be more carefully designed for flow balance than the LTHW system, and the system should be mechanically adjusted to insure balanced heat transfer, he said.

For the 200 F deg drop HTHW system, heat transfer varies almost directly as the change in flow rate. Water flow rates are of extreme importance to satisfactory operation. The piping must therefore be sized with great care; mistakes cannot be made in pipe sizing or pump selection since the water flow-heat transfer design safety factor is of such a low order. The system must be mechanically balanced with precision. The pipe friction drop charts used should be selected with care. The LTHW system is not necessarily a water flow metering heat transfer machine. The HTHW system *is*, he emphasized.

In terms of equipment selection, the LTHW system permits use of any and all of the standard equipment and installation techniques presently in use. The engineer is limited in no way.

The ITHW system operates at temperatures above ASME Low Pressure Boiler Code limitations, i.e., above 250 F. Steel boilers must, therefore, be used. The system will operate at temperatures (around 300 F) and pressures below 125 psig which generally allow use of standard readily available pipe, fittings, heat transfer units, valves, and pumps. Before starting the final design of the ITHW system, the engineer should check possible additional equipment costs as caused by slightly increased design temperatures, he suggested. Savings in pipe and pump size costs resulting from an additional possible design temperature drop may not offset increased special equipment costs.

The HTHW system requires that special attention be paid to equipment selection; all material used must be specially considered because of the temperatures and pressures involved. Special, more costly equipment is involved and much more attention must be given to overall design of the piping system. A HTHW system design, by its nature, approximates power plant design. Piping pressure codes, applicable to power plant design, should be used.

Secondary Controls Important, Too

Secondary individual building control arrangements may vary, depending on design temperatures. Since pressures and temperatures are within the range of standard equipment, LTHW and ITHW systems can use primary-secondary control arrangements as shown in Fig. 3.

For specific systems, differences in equipment costs and control ease can be assessed.

The Aim: Best Results at Least Cost

The engineer's function is to provide maximum results at least cost. Costs for any heating system are, of course, based on design, installation, and operating costs.

To fulfill his basic function, the engineer should compare lower temperature hot water systems with HTHW designs, said Mr. Carlson. Savings due to increased design temperature drop, as made permissible by increased design temperatures, should be economically balanced against problems and costs caused by the increased design temperatures.

The HTHW system need not and should not be compared only with the "conventional" 20 F deg drop system, he said. What is "conventional" for one system may not be conventional or even reasonable for a larger system. The engineer should select the most economically desirable combination of design temperature drop and operating temperature for the specific design.

In closing, Mr. Carlson compared the HTHW system and the ITHW system by asking this question: "How long must the piping system run before the saving in pipe costs, resulting from an approximate reduction of one pipe size, offsets more costly special equipment and increased HTHW design and operating problems?" ≠

New, Revised ASTM Specifications

ASTM SPECIFICATIONS now require that all carbon steel welds in extra heavy or lighter fittings be x-rayed under statistical quality controls which are four times as comprehensive as requirements of the ASME Unfired Pressure Vessel Code. Heavier carbon steel welds and all alloy steel and "high-yield" welds, regardless of wall thickness, are 100 percent radiographed. In all cases, ASME Boiler Code Standards of weld quality are maintained

• New and revised ASTM specifications A 234-58a T, A 403-58a T, and A 420-58 T include several changes in manufacture and heat treatment for butt welding and socket welding fittings that are designed to aid the user and manufacturer alike. An important feature is the addition of new quality control requirements for fusion welds of those fittings having seam welds. This article briefly summarizes these specifications and highlights their changes.

Mr. Holmes is a Yale University graduate in mechanical engineering. As an important part of his duties as staff engineer for Midwest Piping, he represents the company on various committees sponsoring or publishing codes, standards, and specifications. He is a member of ASTM Committee A-1 which has charge of all specifications dealing with ferrous materials. Within this committee he belongs to a subcommittee on pipe, valves, fittings, and flanges, serving on a section on welding fittings which does a lion's share of the work on revisions and writing of specifications.

BY FOSTER W. HOLMES
Staff Engineer
Midwest Piping Co., Inc.

SEVERAL CHANGES are incorporated in the American Society for Testing Materials' new and revised specifications covering wrought welding fittings, recently issued in the *ASTM* 1958 *Book of Standards, Part I.* These specifications are:

1) A 234-58a T — Factory Made Wrought Carbon Steel and Ferritic Alloy Steel Welding Fittings

2) A 403-58a T — Factory Made Wrought Austenitic Steel Welding Fittings

3) A 420-58 T — Factory Made Wrought Carbon Steel and Alloy Steel Welding Fittings of Seamless or Welded Construction for Low Temperature Service.

A 234 has been in existence for 18 years and A 403 for two. A 420 is new this year. For the many users of welding fittings, it should be of interest to summarize these specifications and to highlight the recent changes.

To begin with, it should be noted that all three specifications follow the same pattern, modified only to the extent necessary for the particular type of material or service involved. In general, their outline and context is as follows:

• Scope

This section states that the specification covers butt welding and socket welding wrought fittings. Cast fittings are specifically excluded. (Cast fittings are covered by

Aid Users of Steel Welding Fittings

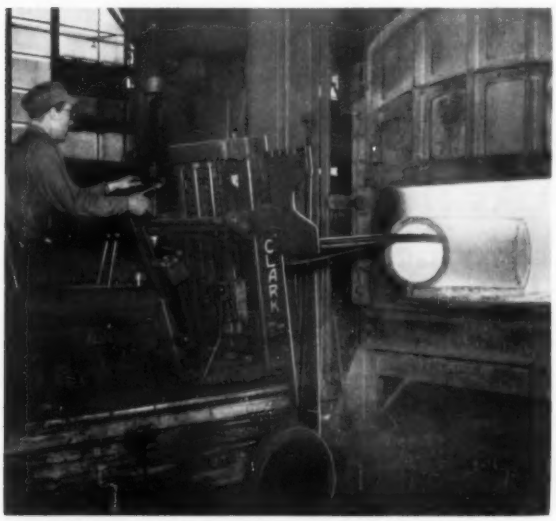
. . . feature new quality control requirements for welds

other ASTM specifications (A 216, A 217, A 351, and A 352) and are not discussed in this article.)

• Materials

In each specification there are a number of different materials grades. This allows the user to pick the particular metal best suited for his conditions. And for each grade there is a choice of raw material shapes or forms. For instance, the most popular grade in A 234 is WPB, a high-strength mild carbon steel intended for use with seamless pipe conforming to A 106, Grade B. For this grade the permissible raw material shapes are: A 106 Grade B pipe; A 212 Grade A or B plate; A 105 Grade II forgings; or A 107 Grades 1025 and 1030 bar stock.

These various specifications all have chemical and physical properties that are, of course, comparable to one another, thus giving the fabricator flexibility in choosing the best form of material for the particular size and shape of fitting being manufactured. For example, fittings 2 in. and smaller quite often are made from bar stock or forgings, while larger fittings are made either from pipe or plate. In the extremely large sizes, usually above 24 in. in diameter, all fittings are made from plate.



HEAT TREATMENT requirements for welding fittings are an important feature of ASTM specifications

• Manufacture

This section gives very general instructions on permissible forging or shaping operations. It also gives detailed instructions on the requirements for welding.

Fusion welding is an important operation in all three specifications and the new quality control requirements for this welding are probably the salient feature of the recent changes and will be discussed in detail.

• Heat Treatment

Although the chemical and mechanical properties are originally set by the ASTM specification of the raw material used, the mechanical properties may be altered by the process of forming the raw material into fittings. For this reason various heat treatments are specified.

For instance, in A 234, because of the possibility that carbon steel fittings may have excessive grain growth when worked at temperatures in excess of 1800 F, normalizing is required to refine the grain. This results in a better combination of mechanical properties. In A 420, all fittings must be normalized, regardless of the forming temperature. This is required to improve the low temperature impact properties.

Another reason for heat treating is to improve corrosion resistance. For example, in A 403, which deals with austenitic materials, a carbide solution treatment is specified to prevent the possibility of intergranular corrosion.

• Tensile Properties and Chemical Composition

These requirements, of course, are set by the ASTM specification for the raw material used. In the case of A 420, Charpy tests are required because of the expected low temperature service conditions.

• Dimensions of Fittings

The dimensions of fittings are specified to be as shown in the American Standards Association Standard for Steel Butt Welding Fittings (ASA B16.9) (See the article *Revise ASA Butt Welding Standards to Simplify Layout, Fabrication*, by H. H. George, in the February issue, for an interesting discussion of the 1958 edition) and the Standard for Steel Socket Welding Fittings (ASA B16.-

11). For lightweight austenitic steel fittings, the dimensions shown in Manufacturers Standardization Society Standard Practice SP 43 apply.

• Marking

This section details the requirements for identifying the finished fitting. The marking of each must include the manufacturer's name or trademark, the size, nominal wall thickness or schedule number, and the identification symbol for the material grade.

This marking is the user's guarantee that the fitting has been made in full compliance with all the requirements of the specification.

Incorporate Quality Control Requirements

The foregoing has given a very condensed summary of what you will find in the ASTM specifications for wrought welding fittings — except for one important subject: *quality control.*

The 1958 changes centered primarily around the quality control of the fusion welds of those fittings having seam welds. It should be interesting to review this subject in some detail.

Prior to the 1958 editions of A 234 and A 403, welding had to be in accordance with the rules and requirements established in the American Standard Code for Pressure Piping (ASA No. B31.1-1955), Section 6, covering fabrication details. This section does not have mandatory inspection requirements of the completed weld, except for visual examination. Now, all three welding fittings specifications have radiographic inspection requirements.

Specifically, a fusion welded seam must be:

1) Welded by welders, welding operators, and welding procedures that are qualified under the provisions of Section IX of the ASME Boiler and Pressure Vessel Code.

2) Heat treated in accordance with the requirements of the *Heat Treatment* section of each specification.

3) Radiographically examined and approved in accordance with paragraph UW-51 of Section VIII of the ASME Boiler and Pressure Vessel Code on the following bases:

A 234 *and A* 420:

a) For carbon steel in standard and extra strong wall thicknesses, a minimum of 4 percent of all fittings must be selected at random, and the seams radiographed throughout their *entire* lengths.

b) For carbon steel heavier than extra strong, and for alloy steel in *any* thickness, *every* fitting must be radiographically examined throughout the *entire* lengths of their welded seams.

A 403:

All standard weight or heavier wall fittings shall be radiographically examined throughout the *entire* lengths of the seams. Radiography is not required for lightweight fittings (Schedules 5S and 10S).

Why Not Use Spot X-Ray?

Those readers who are familiar with Section VIII may ask, "Why not use the spot-x-ray paragraph UW-52 for standard and extra heavy carbon steel fittings which are not required to have 100 percent x-ray?"

The answer is that paragraph UW-51 was intentionally chosen because its quality control provisions are stricter than those of UW-52. For instance, there is a statement in UW-52 that "Porosity is not a factor in the acceptability of welds . . . . . ." In addition, UW-52 requires only 6 in. of radiography in each 50 ft of weld seam. This is only 1 percent, an amount deemed insufficient for proper quality control. These two specific reasons, plus the generally stricter requirements of UW-51, were the deciding factors in avoiding UW-52.

It is quality control requirements such as these that have put teeth in the ASTM specifications for welding fittings. Proof of their acceptance in industry are the thousands of purchase orders issued daily that specify: "Fittings shall comply with ASTM A 234 (or A 403 or A 420). ∓

House Resolution Asks That April Be Annual "Welded Products Month"

RECENTLY before the House of Representatives, Rep. Frank C. Osmers, Jr., of New Jersey, introduced a resolution to designate the month of April in each year as "National Welded Products Month."

In proposing the resolution, Rep. Osmers cited the vital part of welding and welded products in the nation's economy.

"In the power field," Rep. Osmers said, "welding permits higher operating temperatures and pressures. Boilers and supply lines are 100 percent welded — so are tanks for oil and water storage.

"Welded pipelines range from 6 in. in diam to the giants of Hoover Dam — large enough to hold a three story building. These pipelines carry water, oil, gasoline, and natural gas through regions where breaks would be costly. Welded pipes are also used to distribute chemicals, syrups, and other fluids within a single plant or local area," he pointed out. ∓

ABOARD NAUTILUS, today's nuclear powered submarine, samples of air from various compartments are tested for radiation content. Hanging over sink are film strips taken from personnel to determine amount of radiation that might be picked up by crewmen. Each crewman wears container with piece of film

Submarine studies indicate . . .

Airborne Condensation Droplets, Ions May Be Major Health Factors

. . . in habitability of closed spaces

BY KARL E. SCHAEFER
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STUDIES conducted during World War II in Germany to investigate the effects of condensation droplets and ions on human habitability in submarines proved conclusively that gamma radiation has definite bearing on ion production. This led to measurements of gamma radiation aboard the test submarine.

The gamma radiation was measured with a portable counting device developed by Dr. Dreblow. The number of impulses measured within a certain time is recorded and compared with (1) the value of the so-called "zero-effect" and (2) with a "calibration value." The zero effect originates from the "random radiation" measured at a place where no radiation source exists. The "calibration value" was obtained by using as calibration source 1 microgram of radium at a distance of 5 cm in the petty officers' quarters.

Tests were carried out near instruments which had dials painted with self-luminous radioactive material. A great number of these instruments was found concentrated in the control room. The "zero effect" for comparison was measured in the petty officers' quarters away from sources of radiation. It was determined that this compartment agreed well with the values found in the open air. Results are listed in Table 1. It can be seen that the number of impulses recorded in front of the instruments with radioactive paint was considerably higher than the value which corresponds to the zero effect.

The fathometer which had the largest surface covered

• Prolonged submergence of today's submarine has made habitability an important factor in crewmen's well-being. One of the major problems is gamma radiation which emanates from instrument dials painted with self-luminous radioactive material. The details of studies carried out by Germany during World War II to measure gamma radiation aboard a test submarine are presented here. This is the second in a series of three articles. The first appeared in the May issue.

Dr. Schaefer, born in Germany, received his M.D. from the University of Kiel in 1936. During the war he conducted physiological studies at the German Research Institute of Submarine Medicine in Carnac, France. After the war he taught physiology at the University of Heidelberg and served as acting director of the Physiological Institute from 1947 to 1949, editing the German Monograph on Submarine Medicine prepared under the auspices of the U. S. Naval Technical Unit. In 1949 he joined the U. S. Navy Medical Research Laboratory. Dr. Schaefer was instrumental in preparing the program for the First International Symposium on Submarine and Space Medicine, held last September in New London, Conn. He was nominated to become a member of the Armed Forces-NRC Committee on Bio-Astronautics last December.

with luminous paint showed the highest number of impulses. The intensity of the measured radiation can be expressed in ratio to the intensity of radiation produced by a calibration source. The calibration value was determinded with 1 microgram of radium at a distance of 5 cm in the petty officers' quarters.

The relevant values are given in Table 1 and were found to range from 1.86 to 4.30. Values found at the places where the control room watch or the steering personnel normally stay and control the indicators during cruising are of particular interest (Nos. 6 and 7).

Did Radiation Affect Ionization Data?

The fact that there is a continuous effective source of gamma radiation in the submarine in the form of radium painted dials raises the question: To what extent has this radiation affected the measurements of ionization?

Gamma radiation is known to produce an instantaneous ionization; the pairs of ions formed become neutralized immediately. If this instantaneous gamma radiation would have affected the ion measurements to a considerable extent, the ion concentration during submergence and surface operation should be about the same. The more than 10-fold increase of small as well as large ions within 5 to 12 hr of submergence makes such an interference for these measurements unlikely.

The radium of the dials will, however, also produce radon, its radioactive daughter. Radon, a gas, can easily diffuse from the sealed instrument dials into the atmosphere of the submarine. These airborne radioactive particles may precipitate and concentrate on atmospheric condensation nuclei. Radon in turn will emit alpha, beta, and gamma radiation and decay into a series of radioactive daughter elements. Radon and its daughters could affect the ionization measurements, since the air is aspirated into the instruments.

Interference with measurements would be less during surface cruising and would increasingly affect the measurements with prolonged submergence. The noted increase in small and large ions during submergence as well as during closure of the submarine could therefore be due to (1) an actual increase in ions and (2) an increasing interference of the measurement by increasing airborne radioactive particles or radon gas.

The increase in condensation droplets during submergence or closure of the submarine, which is not directly affected by radiation, represents a true increase of atmospheric particles. This increase can be due to rising content of radon and daughter elements as well as other nonradioactive dust particles.

It could be argued that the approximately 10-fold increase in condensation nuclei noted during submergence should produce an approximately 10-fold increase in large ions (since 50 percent of the condensation nuclei are electrically charged and the particle size measured with the condensation droplet counter corresponds with the size of large ions). Measurements of small and large ions show about a 10-fold increase, which corresponds too well with the demanded figures to suspect a significant interference of ion measurements by the radiation of airborne radioactive particles.

What Caused Ion Formation?

Only rough estimations can be made as to the formation of ions by the hard gamma irradiation of the indicator instruments. A possibility of calculations is given by the standards of radium in equilibrium with its daughter.[1] One mg of radium at a distance of 1 cm produces approximately 4.9×10^9 pairs of ions per second in a volume of 1 cc.

Here, the wall effect and the conditions of equilibrium are disregarded. Hence, it results that 1 mg produces 4.9

$\times 10^6$ pairs of ions per cc per sec at a distance of 1 cm or 1.8×10^{10} pairs of ions cc hr.

With our measurements, ion concentrations of an order of magnitude between 10^4 pairs of ions per cc were determined. With about 20 irradiating indicator instruments installed in the control room, the formation of ions and their concentration in the compartment can be roughly estimated by means of the figure computed from Eve's constant.

On the basis of these calculations it can be stated, with some probability, that the quantity of ions produced by gamma rays in this case is sufficient for explaining the measured concentrations of ions we have found and that, for this reason, the radioactive substances in a submarine must be regarded as a *principal source* from which ions originate.

Several Causes of Condensation Droplets

The studies showed that condensation droplets increase during submergence. Approximately 50 percent of the condensation droplets are charged with electricity[2]. The charged condensation droplets belong into the class of ions, and consist of a cluster of small ions surrounding the condensation nuclei. A number of substances in a submarine could conceivably cause the formation of condensation droplets. Among these are sea salt particles, sand paper dust, and exhaust gases escaping through leaks of engines. Charging of a certain amount of condensation droplets (large ions) can be attributed to gamma radiation.

The uncharged condensation droplets can be of biological significance through effects of the substances on mucous membranes. Certain trace substances, ammonium compounds, and nitrites have been found in submarine air[3]. The measured quantities were not high enough to exert toxic effects, but they were considered sufficient to produce a slight irritation.

If an atmosphere contains ammonia, much more is precipitated in the presence of a large number of condensation droplets. On the basis of this finding and the observation that 47 to 90 percent of the inhaled condensation droplets are precipitated in the respiratory tract, it can be concluded that the condensation can be instrumental in introducing toxic substances from the atmosphere droplets into the body. It is certainly necessary to do more investigations of trace substances and condensation droplets in confined spaces in which personnel are required to stay for long periods.

TABLE 1 — GAMMA RADIATION measurements in closed submarine revealed the following data. Petty officers' quarters (No. 1) was taken as location of zero effectiveness for comparison with other areas

No.	Location	Mean value of number of impulses per min.	Absolute number of impulses	Related value of interference
1	Petty officers' quarters	22	...	...
2	Order telegraph starboard	100	78	2.78
3	Indicator of number of revolutions of port side well	111	89	3.18
4	Fathometer indicator	142	120	4.30
5	Gyro compass	94	72	2.57
6	1 m before the diving plane (Location of control room watch)	83	61	2.18
7	1 m before control room and captain's compartment	74	52	1.86
8	Petty officers' quarters	50	28	1.0

Evaluate Results of Studies

The number of small ions measured during the first series of studies in the atmospheric air on the upper deck of the submarine amounted to 1000 positive and 800 negative. The values agree well with those given in the literature for normal conditions[5,6]. During periods of submergence lasting up to 12 hours, ions of both polarities increased in all compartments tested.

Positive ions showed a somewhat greater rise than negative ions. The highest values, up to a 17-fold increase, were measured in the control room. The increase of small ions was confirmed in the second investigation under conditions of simulated submergence. The range of ions corresponded with the first results (13,700); however, no preponderance of positive ions was noted in the second test. The large ions determined in the second study also increased during submergence. Their numbers were considerably higher than those of the small ions, and again a preponderance of the positive ions was observed. The cause of increased ion formation was found in the gamma radiation of the radioactive paints of instrument dials.

The question might be raised: why, during submergence or during the tests, the number of ions is increased, since during submerged and surface cruising with opened hatches, ions are equally formed by the gamma radiation and why in the latter case, the ion cencentrations are considerably smaller. It is most likely that the rather considerable air circulation, amounting to 5 to 7 mph in the control room during surface cruising, carries away the ions and radon gas and daughter products and that even with an opened hatch the replacement of the air is sufficient to prevent an augmentation of the ions.

Other sources for the formation of ions aboard submarines have been considered. Sparking on the instrument boards was checked, but cannot play an important part since it would cause a greater number of ions to be present in the instrument room. Further, the warming up of unpainted iron parts, which can release positive ions, can play an important role[7].

The biological significance of ions found aboard submarines will be discussed in an early issue. ⋕

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the law and your profits

WILLIAM HURD HILLYER, author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background. This series presents actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Hold Up Your End of the Bargain —Or Be Sued for Nonfulfillment

SUBCONTRACTORS must be extremely careful to exactly fulfill their contracts if they expect to be paid their stipulated rewards. In the following case are set forth some of the possible money, time, and legal disappointments which were the result of nonfulfillment.

Pypster Installation Co. was the subcontractor, under general contractor Overem Construction Co., for the installation of piping and allied facilities at an airfield.

Pypster sued Overem for a balance claimed under the subcontract and obtained a trial court judgment in the amount of $11,000. Overem cross-complained, alleging that the subcontractor was obliged under the contract to furnish drawings showing exact locations of underground installations and stating that he also had a contractual duty to compact dirt in trenches.

Both of these things, Overem claimed, Pypster had failed to do. Overem had to do this work and was therefore entitled to damages, he maintained, "notwithstanding the fact that the dollar amount thereof was not proved with mathematical precision."

Overem appealed to the state supreme court. Four errors were assigned in that appeal, the most important, in the higher court's opinion, being the trial court's rejection of Overem's cross-complaint for "so built" drawings amounting to about $1500 plus a sum for compacting trenches.

The drawings, observed the higher court, "show the exact locations of underground installations, and are required by the" airfield "for maintenance and upkeep." The contract required Pypster to furnish the drawings. He having failed to do so, Overem furnished them and "cross-complained for the cost thereof."

The general contractor had made these drawings not only for Pypster but for other subcontractors as well. Overem had a record of their total cost, but he did not keep separate accounts of such work for each subcontractor. However, an engineer testified that he could determine within 10 percent of accuracy the value of time spent for this purpose. He gave as his estimate the sum of $1582.

The trial court decided that nothing could be allowed to Overem on his cross-claim for drawings because he lacked the separate costs. It found that *some* of the trench compacting costs were properly chargeable to Pypster, although the trial judge was unable to find the proportional sum. The fact of damage was "established beyond cavil," but because the dollar amount thereof was not proved precisely the trial court held that Pypster "should be immunized from all liability."

The supreme court did not concur. It said that uncertainty as to the fact of damage is ground for denying liability. But if the fact of damage has been definitely proved, uncertainty as to the dollar amount of damages does not immunize the party responsible.

The controlling rule of law was cited by the court as summarized in the United States Supreme Court's decision in a triple-damage action under anti-trust laws: "The most elementary conceptions of justice and public policy require that the wrongdoer shall bear the risk of the uncertainty which his own wrong has created."

The court cited a recent Washington opinion as well: "While uncertainty as to the fact of damage is fatal, nevertheless, uncertainty as to the amount or quantum of damages is not to be regarded similarly, as fatal to a litigant's right to recover damages."

After passing upon the technico-legal aspects of several minor items, the state supreme court reversed the lower court's decision favorable to the subcontractor and remanded the case to the lower court "with instructions" respecting the general contractor's counter-claims.

We hate to think of Pypster's legal costs caused by not complying with the contract. He must have undergone much nervous strain as well. ≠

Steam Pipe Sizing Data

THIS STEAM pipe sizing data has just recently been made available for publication. It will be continued in the July, August, and September HPAC Data Sheets. All tables are based on dry steam flowing through Schedule 40 steel pipe. The Moody Friction Factor has been used in computing pipe capacities and friction losses.

Tables 1 and 2 (Table 2 will appear in July) are for use in sizing steam piping for low pressure vacuum steam heating systems. They are based on a maximum pressure drop of 3½ psig, or 56 oz, from the start of the supply main to the most remote heating surface. The tables are to be used only for sizing piping in which the steam and the drips flow in the same direction.

For a given system, the sizing of the steam supply piping requires the use of *both* Tables 1 and 2. Table 1, published hereon, is for the steam mains and is based on a maximum pressure drop of 2½ psig, or 40 oz. Table 2, for the piping between the supply mains and the heating surfaces (i.e., branch piping, risers, and runouts), is based on a maximum pressure drop of 1 psig, or 16 oz. It should be noted that the 16 oz pressure drop is *in addition* to the 40 oz drop in the supply mains.

Table 1 is based on an initial steam pressure of 5 psig, whereas the initial steam pressure in Table 2 is taken at only 2 psig to allow for a pressure drop in the mains. The initial pressures were selected as representing average conditions normally encountered in low pressure steam heating systems. Small variations from these initial steam pressure conditions will not materially affect the values in the tables.

Tables 3 and 4, to appear in August and September, are tabulations of friction losses per 100 linear ft of pipe, or the equivalent, which may be used in preference to Tables 1 and 2, respectively.

This data is being published through the courtesy of the Nash Engineering Co.

TABLE 1—STEAM MAIN CAPACITIES for low pressure vacuum systems are listed below and on next page. Data is based on steam at 5 psig (40 oz). Pipe is Schedule 40 steel. Capacities are given in square feet of equivalent direct radiation (To convert to pounds per hour, divide by 4). Velocities are in feet per minute

TOTAL DEVELOPED LENGTH FEET	PIPE DIAMETER - INCHES							
	1"		1-1/4"		1-1/2"		2"	
	LOAD SQ.FT.	VELOCITY F.P.M.	LOAD SQ.FT.	VELOCITY F.P.M.	LOAD SQ.FT.	VELOCITY F.P.M.	LOAD SQ.FT.	VELOCITY F.P.M.
150	440	5200	920	7500	1380	8300	2660	9700
200	375	5300	790	6500	1180	7100	2280	8300
250	335	4700	700	5700	1050	6300	2030	7400
300	305	4300	630	5100	950	5700	1840	6700
350	280	4000	580	4700	870	5200	1690	6100
400	260	3700	540	4400	810	4900	1580	5700
450	245	3500	505	4100	760	4600	1480	5400
500	230	3250	480	3900	720	4300	1400	5100
550	220	3100	455	3700	690	4100	1330	4800
600	205	2900	435	3500	650	3900	1270	4600
650	195	2750	415	3400	620	3700	1210	4400
700	190	2700	400	3300	600	3600	1170	4300
750	180	2550	385	3100	580	3500	1140	4200
800	175	2500	370	3000	560	3400	1090	4000
850	170	2400	360	2950	540	3200	1050	3800
900	165	2350	350	2850	525	3100	1020	3700
950	160	2250	340	2800	510	3000	990	3600
1000	155	2200	330	2700	495	2950	960	3500
1050	150	2120	320	2600	480	2900	930	3400
1100	148	2090	315	2550	475	2850	920	3300
1150	145	2050	305	2500	460	2750	895	3250
1200	140	1980	295	2400	450	2700	880	3200
1300	135	1910	285	2320	430	2580	840	3050
1400	130	1840	275	2240	415	2490	800	2900
1500	125	1770	265	2160	400	2400	770	2800
1600	120	1700	255	2080	385	2310	750	2730
1700	116	1640	250	2040	370	2220	720	2620
1800	113	1600	240	1960	360	2160	700	2550
1900	110	1550	230	1880	350	2100	680	2470
2000	105	1490	225	1830	340	2040	660	2400

(Continued on next page)

TABLE 1 — (Continued from preceding page)

TOTAL DEVELOPED LENGTH FEET	PIPE DIAMETER - INCHES 2-1/2" LOAD SQ.FT.	2-1/2" VELOCITY F.P.M.	3" LOAD SQ.FT.	3" VELOCITY F.P.M.	3-1/2" LOAD SQ.FT.	3-1/2" VELOCITY F.P.M.	4" LOAD SQ.FT.	4" VELOCITY F.P.M.
150	4250	10800	7500	12400	11200	13800	15300	14700
200	3700	9400	6500	10700	9600	11900	13300	12800
250	3250	8300	5750	9500	8500	10500	11800	11300
300	2950	7500	5200	8600	7700	9500	10700	10300
350	2740	7000	4800	7900	7150	8800	9900	9500
400	2550	6500	4500	7400	6650	8200	9200	8800
450	2400	6100	4200	6900	6250	7700	8600	8200
500	2250	5700	4000	6600	5900	7300	8200	7900
550	2150	5500	3800	6300	5600	6900	7800	7500
600	2050	5200	3600	6000	5400	6700	7500	7200
650	1950	5000	3450	5700	5100	6300	7100	6800
700	1900	4800	3350	5500	4900	6100	6800	6500
750	1850	4700	3200	5300	4800	5900	6600	6300
800	1750	4500	3100	5100	4600	5700	6400	6100
850	1700	4300	3000	5000	4450	5500	6150	5900
900	1650	4200	2900	4800	4300	5300	6000	5800
950	1600	4100	2850	4700	4200	5200	5800	5600
1000	1550	4000	2750	4600	4100	5100	5650	5400
1050	1530	3900	2700	4500	4000	4900	5500	5300
1100	1480	3800	2650	4400	3900	4800	5400	5200
1150	1450	3700	2550	4200	3800	4700	5250	5000
1200	1420	3600	2500	4100	3700	4600	5150	4900
1300	1350	3450	2400	3950	3550	4400	4900	4700
1400	1300	3300	2300	3800	3400	4200	4750	4600
1500	1250	3200	2220	3650	3300	4100	4600	4400
1600	1210	3100	2150	3550	3200	4000	4400	4200
1700	1180	3000	2080	3450	3100	3800	4250	4100
1800	1140	2900	2020	3350	3000	3700	4150	4000
1900	1100	2800	1960	3250	2900	3600	4000	3800
2000	1070	2750	1900	3150	2800	3500	3900	3700

TOTAL DEVELOPED LENGTH FEET	PIPE DIAMETER - INCHES 5" LOAD SQ.FT.	5" VELOCITY F.P.M.	6" LOAD SQ.FT.	6" VELOCITY F.P.M.	8" LOAD SQ.FT.	8" VELOCITY F.P.M.	10" LOAD SQ.FT.	10" VELOCITY F.P.M.
150	28000	17100	45500	19300				
200	24000	14600	39000	16600	79000	19300		
250	21500	13100	35000	14900	70000	17100	129000	20000
300	19500	11900	31500	13400	64000	15600	118000	18300
350	18000	11000	29000	12300	59500	14500	108000	16700
400	16800	10200	27000	11500	55000	13400	100000	15500
450	15800	9600	25500	10800	52000	12700	95000	14700
500	15000	9100	24200	10300	49000	12000	90000	14000
550	14200	8700	23000	9800	47000	11500	86000	13300
600	13600	8300	22000	9400	45000	11000	82000	12700
650	13000	7900	21000	8900	43000	10500	78000	12100
700	12500	7600	20500	8700	41500	10100	76000	11800
750	12000	7300	19500	8300	40000	9800	73000	11300
800	11700	7100	19000	8100	38500	9400	70000	10800
850	11300	6900	18400	7800	37500	9100	68000	10500
900	11000	6700	17800	7600	36500	8900	66500	10300
950	10600	6500	17400	7400	35500	8700	64500	10000
1000	10300	6300	17000	7200	34500	8400	63000	9800
1050	10000	6100	16500	7000	33500	8200	61000	9500
1100	9800	6000	16100	6800	33000	8000	60000	9300
1150	9600	5800	15700	6700	32000	7800	58000	9000
1200	9400	5700	15400	6500	31500	7700	57000	8800
1300	9000	5500	14800	6300	30000	7300	55000	8500
1400	8600	5300	14200	6000	29000	7100	53000	8200
1500	8300	5100	13700	5800	28000	6800	51000	7900
1600	8000	4900	13200	5600	27000	6600	49000	7600
1700	7800	4800	12800	5400	26000	6300	48000	7400
1800	7600	4600	12500	5300	25000	6100	47000	7300
1900	7400	4500	12000	5100	24500	6000	45000	7000
2000	7200	4400	11800	5000	24000	5900	44000	6800

TOTAL DEVELOPED LENGTH FEET	PIPE DIAMETER - INCHES 12" LOAD SQ.FT.	12" VELOCITY F.P.M.	14" LOAD SQ.FT.	14" VELOCITY F.P.M.	16" LOAD SQ.FT.	16" VELOCITY F.P.M.
400	161000	17600	208000	18800		
450	152000	16600	195000	17600	275000	19000
500	143000	15600	184000	16700	260000	18000
550	138000	15000	175000	15800	248000	17200
600	131000	14300	168000	15200	237000	16400
650	126000	13700	160000	14500	228000	15800
700	121000	13200	154000	13900	219000	15200
750	117000	12700	150000	13600	211000	14600
800	113000	12300	144000	13000	204000	14100
850	109000	11900	140000	12700	198000	13700
900	106000	11600	135000	12200	192000	13300
950	103000	11200	131000	11900	186000	12900
1000	100000	10900	128000	11600	180000	12400
1050	97000	10600	125000	11300	176000	12200
1100	95000	10400	123000	11100	173000	12000
1150	93000	10100	119000	10800	169000	11700
1200	91000	9900	117000	10600	165000	11400
1300	88000	9600	112000	10100	159000	11000
1400	84000	9200	108000	9800	153000	10600
1500	81000	8800	104000	9400	147000	10200
1600	78000	8500	100000	9100	143000	9900
1700	76000	8300	97000	8800	138000	9500
1800	74000	8100	95000	8600	134000	9300
1900	72000	7900	92000	8300	130000	9000
2000	70000	7600	90000	8100	127000	8800

Winning the Air Conditioning Odor Fight

Round 6:

Blows from Outside the Arena

● A common cause of store odor problems is the practice of locating packaged air conditioning units in or near odor sources and permitting the units to deliver this odor to the conditioned space. This situation can be corrected by sealing cabinet leaks and by insuring that enough outdoor air is being admitted. Mr. Hubbard presents a simple method for measuring air flow as a means to detect insufficient ventilation air.

The author, a long time member of the ASHAE Technical Advisory Committee on Odors and its chairman during 1956-57, was associated with General Electric Co.'s air conditioning department for many years and has had much experience in the design of air conditioning systems.

BY ALBERT B. HUBBARD

EXILE a store cooler and it may still fight back.

Store coolers, or packaged air conditioning units, can ironically become odor offenders because of one of their advantages: they can be placed almost anywhere. Often this means exile to a smelly back room, from which the unit delivers odorous air into the conditioned space.

Since the exiled store cooler will always be with us, an odor investigator should know how to conquer its odor problems. Ventilation, an odor cure discussed in my May article, is one of three solutions.

First, let's analyze why an exiled cooler develops the disease. Its design is based on in-space location and, accordingly, the designer takes no pains to prevent leakage of ambient air into the enclosure. After all, it is supposedly the same kind of air going into the intake grille. But if the conditioner lands next to a kitchen, toilet, or work room, the cabinet leakage air can be pretty smelly stuff.

Technically correct for such applications are central plant air conditioning units, customarily equipped with tight enclosures.

A most striking example of odor borrowed from the back room occurred in a furrier's establishment. Packaged units cooled salons where models showed customers expensive fur coats. The units were in the work room where furs were processed, stretched, cut, and sewed. The odor appeared intermittently. For months I missed a true first-hand impression and had to rely on vague descriptions. The prevailing odor was "chemical" and of less than moderate intensity.

At that time, I didn't know that furriers and their customers are habituated to this expected odor. Then I got a life-size sample of the real offender. It was "monkey house" odor. It could vividly remind you of the rainy day you took the children to the zoo. For the first time I noticed that all inwardly leaking cracks in the unit were literally outlined in fur. The odor above a pile of wetted furs was a duplicate of the trouble-maker in the salons. Quick relief came through covering all cracks and sheet metal joints with masking tape.

I'm not saying that all out-of-space units should be taped, but rather that you must realize that the unit ambient air is included in the air conditioning circuit. Ventilation, a plywood enclosure, or other provision should be included at the outset.

Not Enough Outdoor Air

Measuring ventilation and leakage at the unit may help the investigator with exiled conditioners. Those who lay out and install store coolers may lead a duct to outdoor air but they can't make it drink any. They rarely get as much outdoor air as they expect.

A typical unit has what amounts to an intake plenum with three possible entrances: an ornamental grille, a variable cut-out for connecting an outdoor air duct, and numerous leaks. Room air, entering through the grille and leakage paths, has little resistance to flow. The negative pressure left to draw outdoor air through the ventilation duct usually is 0.01 to 0.05 in. water gage. And typically, that duct takes a long and tortuous path to the outside.

Blame the layout men. Many merely proportion the outdoor air duct cross-section and the intake cross-section to equal the ratio between desired outdoor air and total air flow. If 25 percent outdoor air is wanted, a 10 in. wide duct would be connected to a 40 in. wide intake opening.

Measure Air Flow, Cabinet Leakage

I devised, and used in the field, a simple method of measuring ventilation and cabinet leakage air as percentages of total flow. Only a draft gage of the sensitive slant type is needed. Bring out a rubber tube to the gage from the junction of the three intake flows (in front of the filter is a good place) and take readings. Then, if possible, bring out a pair of tubes from points on either side of a component through which all the air passes, and read the gage. The coil is best, the filter better than nothing, and in a pinch a single tube can be placed in the discharge plenum, if there are discharge ducts.

Both readings are taken with normal operation, then with the ventilation duct closed, and finally with the ventilation duct and recirculation grille closed (if cabinet leakage is desired).

The division of intake flows is:

$$\text{Ventilation percentage} = 100\,(1 - \sqrt{h_{j1}/h_{t1}}\,\sqrt{h_{t2}/h_{j2}})$$

$$\text{Leakage percentage} = 100\,\sqrt{h_{j1}/h_{t1}}\,\sqrt{h_{t3}/h_{j3}}$$

Where:

h_j = pressure at intake junction (pressure drop common to three intake paths)

h_t = pressure drop across component through which total flow passes

$_1$ = all intakes open

$_2$ = ventilation closed

$_3$ = ventilation and recirculation closed.

The two percentages represent ratios of flow through an intake branch compared to total flow *when all three intake branches are open.*

On an existing job, outdoor air can be increased by restricting the recirculation and leakage intakes. A new set of measurements will tell if the remedy is effective. If you are afraid of reducing total air flow, calculate the ratio $\sqrt{h'_{t1}/h_{t1}}$, where the prime denotes the changed system. The result is the new total flow as a fraction of the original. Generally, the flow loss is negligible.

On jobs in the planning stage, I advise sizing the outdoor air duct generously. Also, remember that a good duct may be made ineffective if it is choked at the outdoor end by closely spaced rain louvers.

In closing, let me stress the value of measuring air flow. It often detects a simple, open-and-shut odor case: insufficient outdoor air.

Next month: Coil odors and 13 steps to good air. ∓

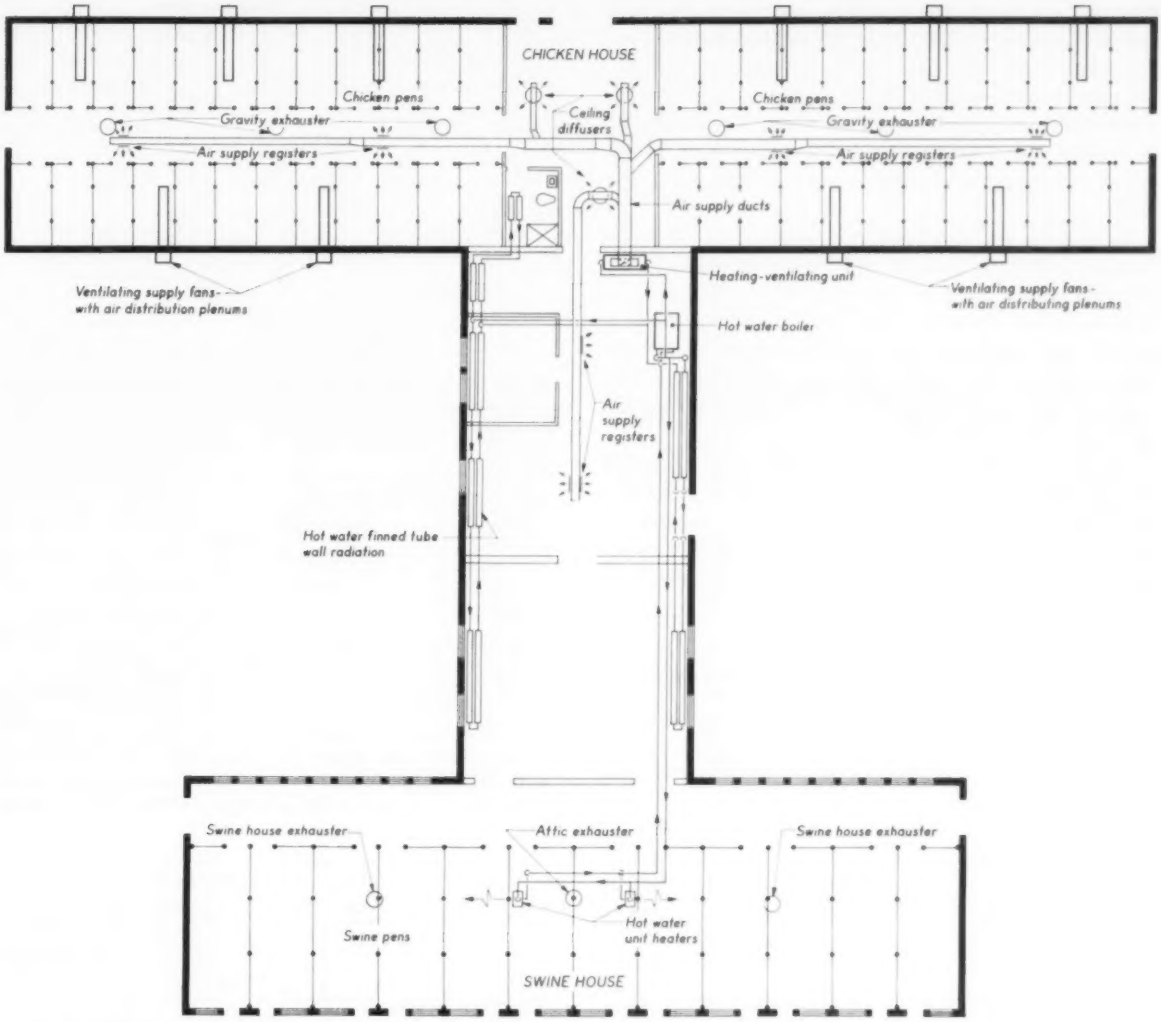
Engineers Must Be Prepared to Fill Tomorrow's Top Executive Jobs

THE CHALLENGE of world competition facing American industry, described as "more complex and more fateful than any set of conditions in our history," will multiply the burdens of engineers in future years, said Brig. Gen. Herbert D. Vogel (retired), chairman of the Tennessee Valley Authority, at the 21st annual American Power Conference held recently in Chicago.

General Vogel urged scrutiny of engineering standards, "because the world in which we live and work is a puzzling complex of currents and countercurrents."

The engineer, he said, must not only continue his traditional role as scientist and builder, but must be able to assume executive positions as management decisions require increased technical knowledge.

Emphasizing the importance of advanced study, General Vogel said: "We must encourage men to go into graduate work; in this connection, industry must watch carefully so that it does not stifle the flow of men into post-graduate study by overtempting promising students with high-paying jobs. Industry can do a great deal — and I do not overlook what it is doing — to widen the horizons of today's engineering graduates through scholarships and fellowships, and through in-service training." ∓



1 PLAN VIEW of chicken and swine building at Abbott Laboratories experimental farm shows outline of heating system air ducts, chicken pen ventilating system, hot water heating arrangements

Evaluate Sensible, Latent Heat Gains For Close Temperature, Humidity Control

BY F. F. STEVENSON
Design Engineer

• Close environmental control at Abbott Laboratories' experimental farm is essential for studying the effects of various feeds on poultry and swine. Because the sensible and latent heat outputs of these animals vary so widely under different conditions, a careful evaluation of design requirements was made by the author before deciding how the close ventilation and temperature control would be achieved.

Mr. Stevenson has had wide experience in the design and installation of heating, ventilating, and air conditioning systems, having done contracting work and been associated with several engineering and architectural firms. In recent years he has served as a design engineer for Abbott Laboratories. ▶▶▶

HEATING AND VENTILATION play major roles in the care and maintenance of animals at Abbott Laboratories' experimental farm near Chicago. On the 220 acre site, the company maintains 6500 chickens, 300 or more swine, about 150 head of cattle, and a few sheep. These are used in various experiments associated with the many activities of Abbott in the pharmaceutical and animal nutrient fields.

Chicken, swine, and lambs are kept in two identical I-shaped buildings, with the two horizontal wings longer than the vertical section. One wing houses the chickens and the other the swine. The vertical section contains service and weighing areas and laboratory, office, and toilet facilities. The wing for chickens is divided into two sections, each approximately 65 × 30 ft, with capacity for about 2400 young birds.

The area of the chicken houses allows about 0.8 to 1.0 sq ft of floor space per broiler and 2.5 to 3.0 sq ft per layer. Whether or not this is adequate will be determined by actual usage. Abbott is using more ventilation air than is customary in chicken pens. With more air, less floor space may be needed.

Various Heating, Ventilating Arrangements Used

Heating and ventilating arrangements for the combined chicken and swine houses comprise the following:

1) Heating and ventilating systems using heated outdoor air for the pen areas

2) An outside air (untreated) ventilating system, likewise for the pen areas

3) A gravity exhaust system to dissipate the air brought in by the ventilating system

4) Hot water radiation heating systems for the service, office, and laboratory areas

5) Hot water unit heaters for the swine wing

6) Power exhaust ventilation, also for the swine wing.

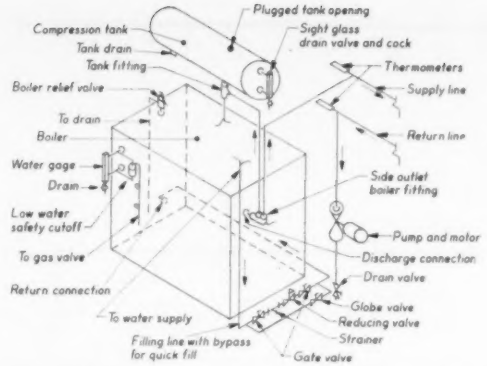
The air system provides 2000 cfm to the chicken pens (1000 cfm to each section) delivered through a duct running the length of the area.

The outdoor ventilating system furnishes 15,000 cfm to the pens, 7500 cfm to each section.

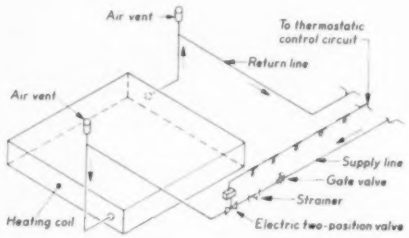
The heating medium is hot water furnished by a propane fired, cast iron sectional boiler in each building. Water is provided at 210 F when the outdoor temperature is −10 F. Boiler capacity is approximately 750,000 Btu per hr and, with a combustion efficiency of 60 percent, the input is about 1,250,000 Btu per hr.

Three propane tanks, each with a capacity of 1000 gal, are located above ground, adjacent to each building. These are filled to about 85 percent of capacity. Approximate vapor pressures at the top of the tanks are 30 psig at zero F, 115 psig at 70 F, and 195 psig at 100 F.

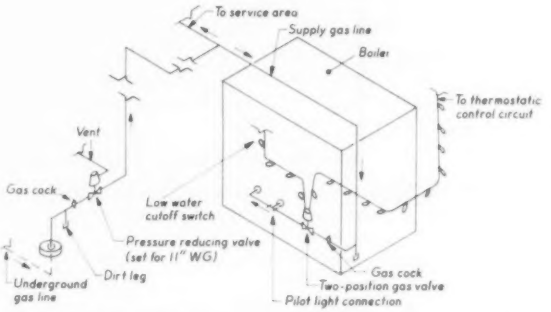
Propane is delivered to the buildings via copper tubing. First stage gas regulator valves in these lines adjacent to the tanks reduce the gas pressure to 15 psig. Just after gas goes into the buildings, second stage regulators reduce the pressure to 11 in. water gage. The line running to the boiler is at this latter pressure and no reducing valve is used at the boiler.



2 HEATING MEDIUM is hot water furnished by propane gas fired boiler. Boiler and compression tank water connections are made as illustrated above



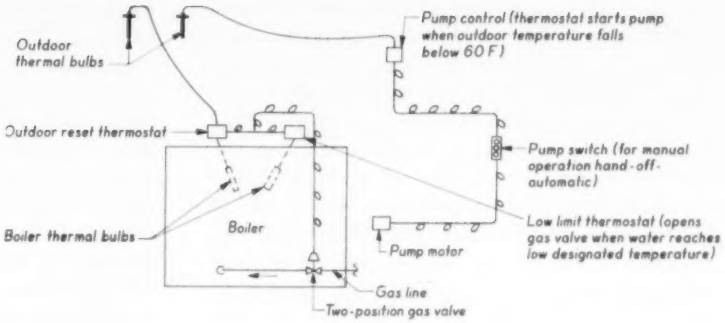
3 AIR for heating, ventilating chicken house is provided by package unit with filters, hot water coil, face and bypass dampers, and fan. Unit uses 100 percent outdoor air at all times. Hot water connections at heating coil are made as shown



4 PROPANE is delivered to buildings via copper tubing. First stage regulators adjacent to tanks reduce existing gas pressure to 15 psig. On entering buildings, this pressure is further reduced to 11 in. W/G by second stage regulator. No reducing valve is used at boiler

The gas valve controlling the flow into the combustion chamber is of the on-and-off type and is regulated by the action of a reset control thermostat which has its temperature setting regulated by the outdoor temperature. The valve also responds to the action of a low limit thermostat to keep the hot water temperature above a designated minimum. In addition, the boiler is equipped with a low water cut-out switch which closes the gas valve when water level reaches a low point.

As stated earlier, the boiler furnishes water at 210 F when it is −10 F outside. On a rise in outdoor tempera-


Outdoor thermal bulbs
Pump control (thermostat starts pump when outdoor temperature falls below 60 F)
Outdoor reset thermostat
Pump switch (for manual operation hand-off-automatic)
Boiler thermal bulbs
Boiler
Low limit thermostat (opens gas valve when water reaches low designated temperature)
Pump motor
Gas line
Two-position gas valve

5 AUTOMATIC boiler control system keeps hot water circulating pump operating continuously until outdoor temperature rises above 60 F. Manual switch in pump wiring can operate pump regardless of outdoor temperature

ture, the reset controller, acting on the gas valve, lowers the water temperature on a 1 to 1 ratio. When the outdoor temperature reaches 50 F, the discharge water temperature is 150 F. This is the minimum setting regardless of outdoor conditions, because, at discharge water temperatures below 150 F, the firing rate is very light and the boiler breeching and stack surface cool down to the point where condensation may occur.

The hot water circulating pump control is independent of the burner control. The pump operates continuously until outdoor temperature rises above 60 F. At this point, an outdoor controlling thermostat acts to stop the pump. When outdoor temperature falls below 60 F the pump starts again. A manual hand-off-automatic switch, in the pump wiring circuit can operate the pump regardless of the dictates of the outdoor controller.

Package Unit Circulates 100 Percent Outdoor Air

Air for heating and ventilating the chicken house is provided by a package type heating-ventilating unit with filters, hot water coil, face and bypass dampers, and fan. It uses 100 percent outside air at all times.

Hot water flowing through the coil is regulated by a two-position electric control valve actuated from space thermostats. One valve serves each section of the chicken area. The thermostats also control the face and bypass dampers through an electric damper motor.

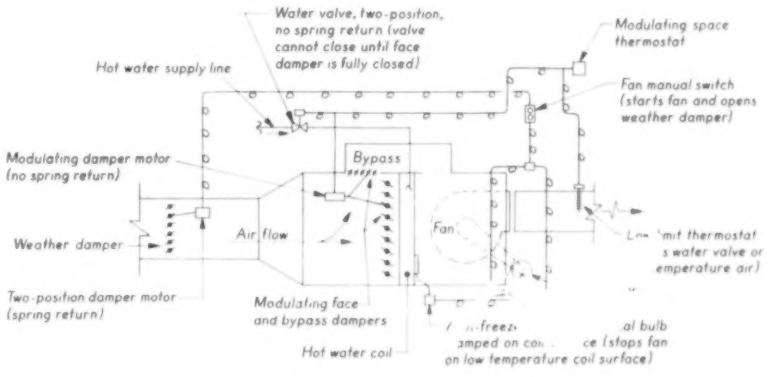
The fan in the unit is controlled by a manual switch, with the circuit arranged so that when the fan is started the normally closed weather damper is opened.

Operation of the water valve and the face and bypass dampers is synchronized as follows: With the fan running and both thermostats satisfied, the water valve and the face damper are closed and the bypass damper is open. When one or both thermostats call for heat, the valve is opened. On a continued call for heat, the face damper starts to open in a modulating manner and the bypass damper starts to close. At peak heating load the valve is open, the face damper wide open, and bypass damper fully closed. When the thermostat is satisfied, the reverse cycle takes place. The damper motor has no spring return, so the damper position is always that dictated by the thermostat. The same arrangement is used with the water valve.

Note that the valve is open before the face damper starts to open. This is to prevent a freeze-up, which is an ever present danger with a 100 percent outside air stream flowing over a heating coil. Even with air dampers having lipped edge interlocking blades and felted, there is always a small air flow, 5 to 10 percent, when the damper is in its tight closed position.

Anti-Freeze Thermostat Guards Against Freeze-ups

A freeze-up could occur in this situation if it were not for the action of an anti-freeze thermostat which will stop the fan and close the weather dampers when the coil surface temperature reaches a designated minimum. This control also serves, when the system is started after a shutdown, to keep the fan from running until the heating coil has warmed up.


Water valve, two-position, no spring return (valve cannot close until face damper is fully closed)
Modulating space thermostat
Hot water supply line
Fan manual switch (starts fan and opens weather damper)
Modulating damper motor (no spring return)
Bypass
Weather damper
Air flow
Fan
Two-position damper motor (spring return)
Modulating face and bypass dampers
Hot water coil

6 CHICKEN HOUSE heating-ventilating unit is controlled as shown at right. Use of 100 percent outdoor air makes danger of freeze-ups ever present. Synchronization of water valve with face damper, plus anti-freeze thermostat, minimize this possibility

A low limit thermostat, with its thermal bulb in the duct just off the discharge of the heating-ventilating unit, also serves as a safety control. It will open the valve and face damper, regardless of the dictates of the space thermostats, when the supply air falls below a certain fixed temperature. This is also useful in the spring and fall, when the heating load is negligible but a supply of tempered air is desired. The thermostat in either section of the chicken house can turn on the heat. However, it may be possible that, while one section may need heat, the other may not. Such a condition may readily be caused by variations in the bird population. To meet this contingency, a manual damper has been placed in the duct branch leading to each area, so the supply of heated air may be restricted or entirely cut off when necessary.

The outdoor air ventilating system handles much more air than the heated air system, 17,000 cfm against 2000 cfm, but the former may be reduced to 10,000 cfm by running the fans at low speed.

Each propeller fan, driven by a two-speed motor and located on the side walls of the chicken areas, blows into a distribution plenum, built of wood, with air outlets on each side and at the end. The outside air used in these systems is not tempered nor treated at any time.

Fan motors in each section are regulated by space thermostats, which, during the summer when the temperature rises to a certain point, start the fans on low speed. If the temperature continues to rise, they put the fans on high speed. The thermostats, of course, will have different settings in winter and summer.

At full volume, both ventilating systems provide 6.6 cfm per bird, 4.7 cfm per sq ft of floor space, and 36 air changes per hr. At reduced air volume, the systems supply 4.6 cfm per bird, 3.4 cfm per sq ft, and 25 air changes per hr. These air volumes exceed the usual standards. However, with a full population of birds and allowing the litter to build up on the floor, Abbott has learned that large amounts of air must be used to dissipate the ammonia fumes generated by the chicken droppings.

Gravity exhausters on the roof of the chicken house, with manually regulated dampers, remove the air supplied by the ventilators.

Heat Emissions from Chickens Vary

Sensible and latent heat emissions from chickens vary widely with the temperature. At a temperature of 50 F the sensible heat emitted by a 5 lb layer is taken as 40.4 Btu per hr and the latent heat as 6.0 Btu per hr. At 100 F, the sensible heat is 9.1 Btu per hr and the latent, 37.4 Btu per hr.

Therefore considerable amounts of water vapor must be removed from chicken houses in summer and much less in winter. The problems in winter, in addition to the ammonia fumes, are (1) the temperature of interior surfaces, i.e., walls, ceilings, doors, and windows and (2) the dewpoint temperature of the space. If the surface temperatures are low and dewpoints high, then some of the surfaces may condense moisture and dripping will occur.

In summer, the indoor dry bulb temperature must be kept as close as possible to the outdoor temperature. This means that the sensible heat emitted by birds and lights must be removed by the supply air. Also, large amounts of water vapor must be carried off by the supply air so that the dewpoint temperature of the space is not excessive and no condensation occurs. Outside temperatures of 60 to 70 F may be more difficult from this standpoint than extremely high or low temperatures.

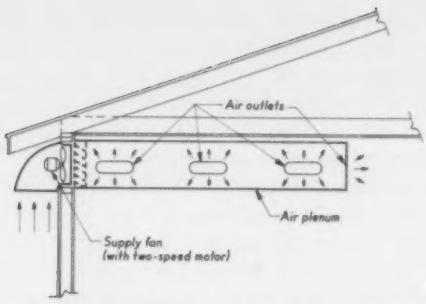
Consider the conditions at −10 F outside: The inside design dry bulb temperature for all outdoor conditions up to 50 F is taken as 50 F. Under these circumstances, the heat gain from the chickens and lights exceeds the heat loss from the structure, the net gain being some 66,000 Btu per hr. Using the minimum quantity of air, 12,000 cfm, the temperature of the mixture of heated air from the ducts and outside air from the ventilators will be approximately 7 F. To absorb the cooling load will require a diffusion temperature (difference between space temperature and supply air temperature) of 5 F. Then, the supply air temperature should be 50 − 5, or 45 F.

If the area were held at 35 F instead of 50 F, the diffusion temperature would be about 4 F and the supply air temperatures 35 − 4, or 31 F. However, the actual supply air temperature from the system is 7 F. So, with a full bird population at −10 F outside, there are two alternatives: (1) cut down the air supply drastically, which would not be suitable with a heavy bird population, or (2) install electric air blast reheaters at the outlets of the 10 ventilators. This would be a practical arrangement, but the possibility of capacity bird occupancy, all layers, and an outdoor temperature of −10 F may be remote. To raise the temperature of 10,000 cfm from −10 to 31 F would require the addition of some 52,000 Btu, or about 15 kw of electric power.

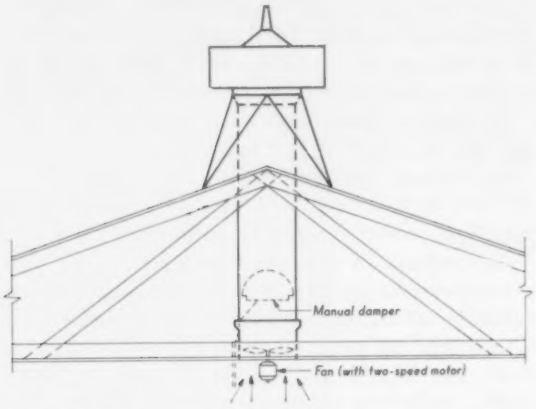
As to the latent conditions at −10 F, the following may be noted: Using an indoor temperature of 50 F, the latent heat emitted per layer is 6 Btu, or a total of 15,600 Btu per hr. This amounts to 103,000 gr of moisture per hr. Using the minimum air volume, the weight of 12,000 cfm is 62,000 lb per hr. To absorb the amount of water vapor present in the space, a split of 103,000 /62,000, or 1.6 gr per lb of air, is required.

Assume a relative humidity in the space of 40 percent. This is a specific humidity of 16 gr per lb and a dewpoint of 21 F. Taking the required split as 2 gr per lb, air at 16 − 2, or 14 gr, must be supplied. The moisture content of saturated air at −10 F is 3 gr per lb. So there is an actual split of 16 −3, or 13 gr per lb. This far exceeds the requirements.

Calculations at 30 F outside and 50 F inside indicate a net heat gain of 76,000 Btu per hr. Using the maximum amount of supply air, a diffusion temperature of about 4 F is required. The temperature of the supply air is 36 F, so the space temperature will be 36 + 4, or 40 F. This is 10 F under design. If it is desired to have a higher space temperature, the minimum volume of



7 EACH PROPELLER FAN in chicken house, driven by two-speed motor and located on side walls, blows into distribution plenum with air outlets on each side and at end



8 GRAVITY EXHAUSTERS on roof of chicken house, with manually regulated dampers, remove air supplied by ventilators. Two power roof ventilators, each handling 2500 cfm at high speed, exhaust air from swine house

air could be used, affording a space temperature of 45 F.

Considering the latent heat conditions at 30 F outside and assuming a relative humidity of 50 percent and 26 gr per lb, the following may be noted: The supply air at 30 F and 100 percent RH will have a grain content of 24 per lb of air. Using the maximum amount of air, a grain split of 103,000/82,500, or 1.3 gr per lb of air is required. Abbott has an actual split of 2 gr per lb so the design relative humidity can be satisfactorily met. Using the minimum amount of air, the requirements could just about be met. The dewpoint of the space will be 32 F.

Different Problems Exist at 95 F Outside

When it is 95 F outside, entirely different problems exist. Again, it is desirable to hold the dry bulb of the space as close as possible to the outdoor temperature. As the supply air is not cooled, large volumes of air are needed. Let's assume a space temperature of 100 F: As this is higher than outdoors, there is no heat flow into building by straight conductance. Without the effects of solar heat, the flow is the other way. However, in our case, there is a solar heating effect on the south wall in the afternoon and a heavier effect on the roof.

In other words, the roof surface temperature may rise to 130 F or higher. The sensible heat gain of the building may be summarized as follows:

Structure	12,600 Btu per hr
Birds, at 9.1 Btu	23,700 Btu per hr
Lighting	21,500 Btu per hr
Total gain	58,000 Btu per hr

Using 17,000 cfm of air, the diffusion temperature is 3.5 F. With air entering at 95 F, the temperature will be 95 + 3.5, or 98.5 F. This meets design conditions.

Chickens Create 97,500 Btu per Hr Latent Load

The latent load of the chickens is high, 37.4 Btu per bird per hr, making a total hourly load of 97,500 Btu. This converts to 630,000 gr per hr. Using 17,000 cfm, it will need an 8.5 gr split between the specific humidity of the space and the supply air to absorb the latent load.

Assume the outdoor relative humidity to be 60 percent, a specific humidity of 150 gr per lb, a condition very seldom encountered in the Chicago area: With an 8.5 gr split needed, the space specific humidity would be 158.5 gr per lb. The relative humidity would be about 67 percent and the dewpoint 80.5 F. However, the dewpoint would hardly ever reach such a figure. Even during hot, humid weather, the specific humidity of the outside air seldom exceeds 130 gr per lb. This would give a space relative humidity of about 56 percent and a dewpoint of about 76.5 F, which is satisfactory.

When it is 70 F outside, the heat gain from the birds and lighting amounts to 91,300 Btu per hr. The diffusion temperature will be about 6 F. At the above temperature, the sun effect on the building is not large. So there will be a small heat flow from the building to the outdoors. Assume an inside space temperature of 75 F.

As to the humidity in the space, assume 78 percent RH, with the air having a moisture content of 104.5 gr per lb. To absorb the latent heat emitted by the birds and using 17,000 cfm of air, a split of 4.5 gr between space and s pply air is needed. So, there is specific humidity in the space of 104.5 gr per lb and a relative humidity of 78 percent with a dry bulb of 75 F and a dewpoint of 67 F. This is within allowable limits.

To check the interior surface temperatures of the chicken house with the dewpoints in the building under varying outside temperatures, heat flow calculations were made. Temperatures were 30 F outside and 50 F inside, a difference of 20 F. These calculations revealed:

	Coefficient, c or K	Resistance, R
Exterior air film	6.00	0.17
Wall, ⅜ in. wallboard	2.70	0.37
Air space, 1 in.	1.11	0.90
Glass fiber insulation, 2 in.	0.25	8.00
Vapor barrier	...	...
Wall, ⅜ in. wallboard	2.70	0.37
Interior air film	1.60	0.63
		10.44

Overall $U = 1/10.44 = 0.096$ Btu per sq ft per F temperature drop per hr.

To simplify the calculations, let's take U as being 0.10 Btu. This causes a discrepancy of only 0.75 F in the temperature gradient figures. The heat flow is $1 \times 0.10 \times 20 = 2$ Btu per sq ft per hr.

Temperature gradients across wall, inside to outside

50 F Inside temp. diff.		30 F Outside surface temp.*
0.63 × 2.0 Btu =	1.26 F	50.00 − 1.25 F = 48.75 F
0.37 × 2.0 Btu =	0.74 F	48.75 − 0.75 F = 48.00 F
8.00 × 2.0 Btu =	16.00 F	48.00 − 16.00 F = 32.00 F
0.90 × 2.0 Btu =	1.80 F	32.00 − 1.75 F = 30.25 F
0.37 × 2.0 Btu =	0.74 F	30.25 − 0.75 F = 29.50 F
0.17 × 2.0 Btu =	0.34 F	29.50 − 0.25 F = 29.25 F

*For convenience, fractions of F are taken as the nearest value to 0.25, 0.50, and 0.75.

Note that the vapor barrier is placed on the interior side of the insulation. For winter, this is the proper place; it will stop the flow of water vapor from inside to outside and keep vapor from condensing and freezing in the insulating material. However, it will not stop the flow of moisture from outdoors through the wall during the summer. The answer here is to use insulation that is impervious to water vapor. Of course, condensation is not a problem during the warmer months, but it might be in the spring and fall.

Observe that at 30 F outdoors no part of the insulation is at a temperature below freezing. However, freezing temperatures will start in the outer side of the insulation at outdoor temperatures around 28 F. Also note that the interior wall temperature is 48.75 F. The dewpoint of the space under these conditions has been previously estimated at 32 F. No wall condensation will occur.

Another check on the heat flow through the wall at −10 F outside reveals that the transmission is $1 \times 0.10 \times 60 = 6.0$ Btu per sq ft per hr. The resistance is 0.63. The interior wall surface temperature computed as before will be $50 - (0.63 \times 2) = 48.75$ F. The dewpoint of the space under these conditions will be 21 F or less, so there is no danger of condensation here.

At 95 F outside, there will be a slight heat flow through the wall to the interior space at peak solar intensity. Since a space temperature of 98.5 F is being maintained, the interior wall temperature will not be lower than this. The dewpoint of the space under maximum humidity conditions will be less than 80 F, so no condensation is expected. The ceiling of the chicken house, with 4 in. of glass fiber insulation and an air space above, will have far more resistance to heat flow than the walls. Again, condensation will not be a problem.

As for windows and doors, the heat transfer through them is infinitely greater than through the insulated walls and ceiling. It may be almost impossible to stop condensation under certain circumstances. However, the magnitude of these surfaces is insignificant and a little dripping at times will not be serious.

Hot Water Unit Heaters Serve Swine Wing

The swine wing is served with two hot water unit heaters, with a horizontal blow, handling 1200 cfm of air each. Design temperature for this area is 45 F when it is −10 F outside. These heaters are controlled by space thermostats acting to start and stop the fans. A three-way hand-off-automatic switch, is used so that the heaters can deliver unheated air during months when no heat is required. A low temperature limit is provided by wiring the thermostat in series with a stat having a thermal bulb clamped to the unit heater surface. The area of the swine house is approximately 3000 sq ft. This affords about 25 sq ft per animal, a population of 120 pigs.

To exhaust air from the swine house, two power roof ventilators are used, each handling 2500 cfm at high speed. Two-speed motors drive the fans and, at low speed, the volume is 1800 cfm. At maximum air volume, the ventilation system provides 1.67 cfm per sq ft and 12 air changes per hr. Windows are placed in three walls of this building and, for the purpose of makeup air, are opened as required. Manual dampers are in the air ducts leading to the ventilators.

To reduce the heat gain in the swine area during the summer, the peak roofed attic is ventilated with a power roof exhauster handling 2500 cfm. This ventilator affords 15 air changes per hr. To furnish makeup air for the exhaust, one louvered intake is placed in each short wall of the building. Each louver has a gross face area of 4 sq ft and has a free area of about 50 percent. The area of the intakes is predicated on the rule of thumb to provide 0.267 sq ft of gross louver area per 100 sq ft of floor space. Face velocity through the intakes is 625 fpm.

The ventilation of attics to reduce heat gain in summer is a controversial question. With no ventilation and comparatively still air, the heat transmission is almost wholly by radiation from the interior side of the roof to the floor of the attic. With a small amount of ventilation, heat is transferred by convection as well as radiation. When greater amounts of ventilation air are used, the radiant heat effect is diminished by the currents of air "wiping" the hot surfaces which have received the radiant heat. This action causes the air to absorb the heat and remove it through liberally sized outlet openings. Movement of air at higher velocities also interrupts the heat flow by convection. Therefore, when power ventilation is employed, be sure that it is adequate. When the roof is a good heat barrier and the attic floor well insulated, gravity ventilation is often sufficient.

A few words about the use of propane gas for combustion may not be amiss. The boiler, with a load of about 750,000 Btu per hr and a combustion efficiency of 60 percent, uses about 12 or 13 gph of propane. This may be converted to about 50 lb per hr or 7 cfm of gas. One cu ft of gas requires about 25 cfm of air for theoretical combustion. In practice, however, about 50 percent excess air is used, and this brings the air volume up to around 300 cfm. With this amount of air, the CO_2 rate in the stack should be 8 to 10 percent. It is necessary to provide means for 300 cfm or more of air to easily reach the boiler at all times. This can be done with openings in wall or similar, if gravity flow can be induced. Otherwise power ventilation is necessary.

The heating, piping, and air conditioning contractor for this installation was National Korectaire Co. The ventilating contractor was H. S. Kaiser Co.

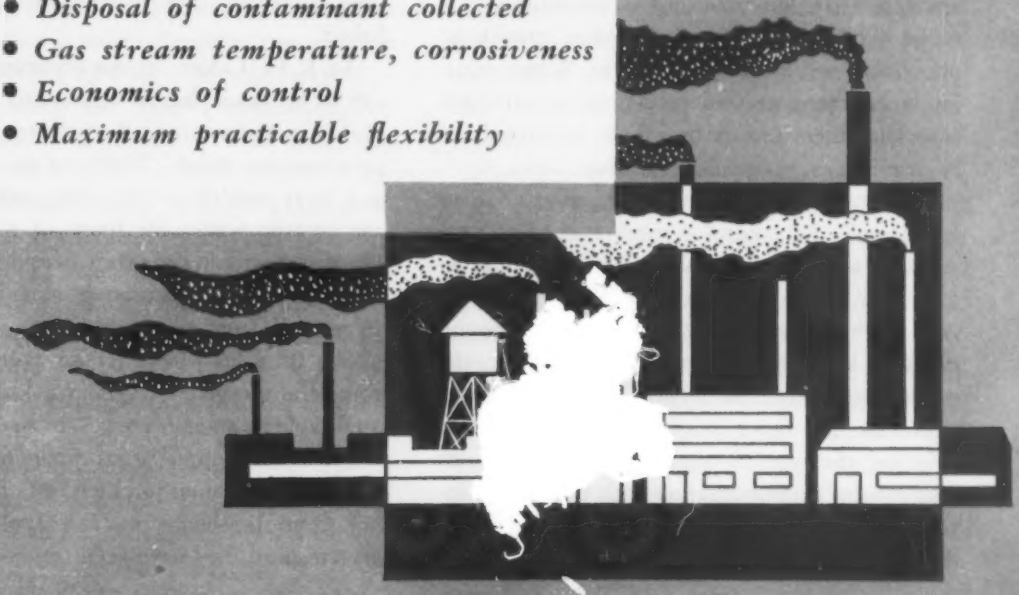
The author wishes to acknowledge the assistance of Bernard F. Tabbert in preparing the illustrations for this article.

HPAC ENGINEERING DATA FILE

How to Control Particulate Emissions to Abate Air Pollution

Some factors to consider:

- *Permissible rates of emission*
- *Particle size, concentration*
- *Disposal of contaminant collected*
- *Gas stream temperature, corrosiveness*
- *Economics of control*
- *Maximum practicable flexibility*



When selecting control methods to minimize particulate emissions, a number of factors must be considered. These include the character of the pollutant, particle size and the total weight of contaminant emitted per day, the temperature and corrosiveness of the gas stream, and disposal of the material collected. The economics of controlling emissions from a given process must also be studied. Such things as initial, operation, and maintenance costs; the value of the contaminant collected; and the reduction of heating and air conditioning costs are factors that must be considered in evaluating the economics of control.

How well a system performs its task of controlling air pollution will depend upon how well its performance fits the duty for which it is intended. Characteristics of the common types of control equipment that have been used to collect solid and liquid particles carried in exhaust gas streams are presented in this report. Where they have been applied, and some experience based design and installation tips that will help avoid unsatisfactory results, are also presented.

THE CONTROL of atmospheric emissions from combustion and industrial processes has become necessary in many localities. Where concentrations of atmospheric pollutants have increased to undesirable levels, legal restrictions have been placed upon the amount of contaminants that may be emitted by a particular process. These regulations apply to commercial and industrial space heating equipment as well as to power generation and production processes.

In the February "HPAC Engineering Data File" some of the factors to be considered in evaluating the need for air pollution control were presented. The local topography, meteorology and contaminants emitted — both kind and amounts — are important in such an analysis. Not to be overlooked are the anticipated growth of population and industry in the area. Where legislation has been enacted to control contaminant emissions, these factors have been accounted for in arriving at permissible emission rates.

Much of the uncertainty in designing a system for air pollution control is eliminated when legal emission rates are established. These provide the minimum goal for design. All that then remains is to establish the amounts and types of contaminants in the process involved and to select the proper equipment to control the contaminant emissions. The latter is not always an easy task. Selecting the type of control for a new process may require experimentation with the process involved and considerable judgment on the part of the designing engineer. Pilot plant studies may be needed in some cases. As more and more air pollution control solutions are devised and reported, the basic knowledge for various sources increases and the selection of equipment becomes less difficult.

When local regulations have not been established, and an air pollution problem prevails — as evidenced by complaints of dustfall, damage to vegetation or other evident signs of undesirable emissions — the designer must first determine the nature of the problem. This will require a study of the complaints, and an evaluation of the pollutants causing the problem. Through cooperation with interested local officials and the community and considering the economics of control, the degree of control to be achieved can then be established.

As J. H. Carter, smoke commissioner of the city of St. Louis, has so well stated regarding air pollution, the nature of the problem "depends upon where you stand." That is to say, air pollution is a local problem — one which may be of varying severity within the limits of a municipality. On the other hand it may cross political boundaries and embrace bordering states or countries. Experience from a particular area, while adding to the total knowledge of air pollution and its control at acceptable levels, is not always directly applicable to another area. While searching for a solution in one area, it is important that known sources of pollution in other areas be considered, but controls should not be applied to these sources until they have been isolated as the *local*

problem. Controls are often expensive and they must be justified to prevent a needless burden on the owner.

When a survey is required to measure the need for control and to isolate the sources of pollutants, ASTM Standard D1357-57, "Recommended Practice for Planning the Sampling of the Atmosphere," or parts of it, should prove helpful. This standard outlines the important factors and major variables to be considered in such a study. Other ASTM test methods for sampling the atmosphere for specific pollutants are listed at the right. As present methods for testing for other pollutants are simplified and refined and agreement is reached by those actively engaged in air pollution survey and enforcement, more standard procedures will undoubtedly result. A number of reports have been published[1,2,3] on methods of measuring concentrations of specific pollutants. These methods are, in general, too detailed to report here. They will be of interest to anyone responsible for measuring atmospheric contaminant concentrations, however.

Concentrations of specific air pollutants can be measured by following the procedures in these ASTM Standards[a]

Odorous vapors:	D 1354-55T
Sulfur dioxide:	D 1355-58T
Odors:	D 1391-57
Gases and vapors:	D 1605-58T
Inorganic fluoride:	D 1606-58T
Nitrogen dioxide or nitric oxide:	D 1607-58T
Oxides of nitrogen in gaseous combustion products:	D 1608-58T
Oxidant (ozone):	D 1609-58T

[a] *Available from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.*

Some of the terms relating to atmospheric sampling and analysis have been tentatively defined in ASTM Definitions D1356-58T. Knowledge of these definitions may prove helpful in understanding information reported on the subject of air pollution.

How Air Pollution Can be Controlled

The possible methods of controlling air pollution as given in the paper[4] by C. E. Lapple at the National Conference on Air Pollution are:

Source control (process control)
Effluent gas treatment (control equipment)
Effluent gas dispersal (stacks)
Community action — a) zoning, b) treatment

Source control is accomplished by changing the basic process involved so as to prevent the production of pollutants. This type of control may not be economically feasible and, in some cases, may be impossible to attain at any cost without eliminating the process entirely. A simple example of source control is the banning of open fires. Another example is banning the use of fuels with high sulfur content during the critical six months in Los Angeles. This requires substitute fuels wherever power and process heating is needed and is only enforceable when low sulfur fuels are available.

Dispersal of pollutants through the use of stacks was discussed briefly in the February report. Wise use of the atmosphere for dispersal of contaminants can be an economical means of avoiding an air pollution problem. Stacks are effective in maintaining acceptable ground level concentrations in the vicinity of the stack. However, since the pollutants are discharged to the atmosphere, they may cause problems elsewhere. Local meteorology and topography must be considered in stack design. Stacks may be used in conjunction with gas cleaning equipment to provide the least expensive solution to a pollution problem.

Zoning may be used by communities to minimize pollution. Local weather and topography also determine the effectiveness of this means of control. A community might elect to *treat* the air as it treats its water supply. It is evident that this would require equipment and, perhaps, new concepts of enclosing cities not presently available. It is not likely that this means of control will be practical in the forseeable future.

The most used method of control to date is the treatment of effluent gas streams by means of various devices. The devices used for control are presented in this report.

[1,2,3] *Superior numerals refer to references listed on page* 152.

What to Consider When Selecting Equipment

Once the degree of air pollution control required in a particular locality is known — either by survey or reference to applicable codes — a number of factors must be considered in selecting equipment. These include but are not limited to the following[8]:

1) The *character* of the contaminant. Gases, vapors, and odors must be treated differently than particulates which include dust, fumes, and liquid sprays or mists. In some cases the effluent may contain a mixture of gaseous and particulate contaminants.

2) The *concentration* of contaminants in the effluent. This is usually reported as dust loading in grains per cu ft or pounds per 1000 lb of gas in the case of particulates and in parts per million by volume in the case of gases. This, together with the total gas flow, is used to determine the total amount of contaminant that must be collected and disposed of.

3) *Particle size and size distribution.* These are important in selection of equipment for removal of particulates. Some codes limit maximum emissions of certain particle sizes. Also, dust collector efficiency is reported on the basis of particle size.

4) *Temperature* of gas stream to be cleaned. This may affect the choice of materials used in the collector and the collector efficiency. It is especially important when considering the use of cloth type filter media. The stream temperature is also needed when determining compliance with local codes that state standard conditions (not always 70 F and 29.92 in. Hg) at which emission will be evaluated.

5) *Corrosive* components in the gases. These are important from the standpoint of control equipment materials and may influence the type of collector chosen for a particular service.

6) *Disposal* of collected material. Secondary pollution problems may result if this is not considered in design. For example, stream and ground water pollution may result if contaminants collected in wet processes are discharged without treatment to streams.

7) *Safety hazards* introduced by collection. Possibility of combustion and explosion must be considered.

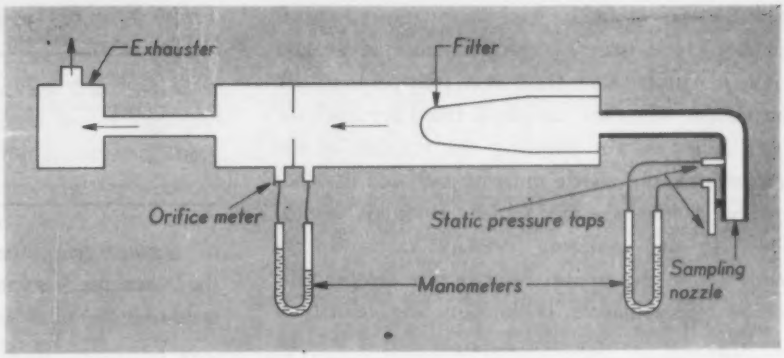
8) *Economic factors.* Such things as initial cost, operating cost, maintenance required, value of contaminant removed either as product recovered or usable heat recovered, and savings in cost of air conditioning if cleaned process exhaust air can be returned to the occupied space should be included in the economic analysis for a particular air pollution control problem. These factors must be weighed in making the final selection of control equipment.

In some cases, the value of product recovered may quickly repay the cost of control. In these cases, a degree of cleaning much higher than that demanded by code may be justified. In other situations, control will not result in any tangible returns but intangibles, such as public relations, may also warrant a higher degree of cleaning than the minimum required to satisfy local legal requirements. In either case, careful consideration must be given to the economics of control.

9) Design for *maximum practicable flexibility* of equipment. Since only limited information is available on air pollution control on a community-wide basis, allowance should be made whenever possible for some additional room for equipment, and additional pressure drops or increased air volumes to permit adjustments based upon operating experience.

Dust Load and Particle Size Are Important

Of the many factors to be considered in the selection of control equipment, two should be considered in detail before discussing particulate control equipment. These are particle size and size distribution, and dust loading or concentration. These criteria are important because of their effect on collector efficiency and determination of the need for control. They are, therefore, necessary to the selection of adequate control for particulate emissions. Other important variables are specific gravity of the particulate and the temperature of the gas stream.



1 SAMPLING DEVICES used for collecting dust samples in accordance with ASME Power Test Code 21 must have basic components shown at right. A number of variations of each basic component are approved

How Dust Loading Is Determined

Many air pollution control ordinances cite The American Society of Mechanical Engineers Power Test Code 21-1941, "Test Code for Dust-Separating Apparatus," as the method to be used in determining compliance with particulate emission requirements. Methods of sampling and data evaluation are provided in the code that give a satisfactory measure of separator performance. Some of the important sections of the code are reviewed here. If a test is to be performed, the entire code should be studied.

The rules set forth in PTC-21 provide for determination of any one or all of the following performance factors:

1) The overall efficiency on a weight basis.

2) Efficiency of separation according to particle size.

3) The pressure drop through the separator.

4) Dust concentrations at inlet and outlet.

5) The particle size distribution of the entering, leaving, and collected dust.

6) The combustible content of entering, leaving, and collected dust.

7) The quantity of gas flowing in the system.

Where the dust load from an existing process is unknown, these procedures can also be used to determine the design dust loads.

When measuring field performance, a number of variables must be agreed to prior to the test. Some of these are the time for the test, what adjustments if any must be made to the collector to assure proper operation, the number and location of sampling stations to assure collection of a representative sample, the method by which steady flow of the process will be achieved and maintained, the method of determining gas flow through the equipment, the number of tests to be run, and the laboratory that will make the size analysis. Some of these variables may influence the results, and some care must be exercised in their selection.

The selection of sampling stations should be given particular[6] attention. Samples usually should be taken at a number of points across the duct or stack. The dust concentration will vary across a duct due to turbulence and the choice of sampling tube locations should be based upon the same considerations as those for locating a pitot tube when measuring velocities of gas streams. When heavy dusts are being transported in horizontal lines, the dust near the bottom will usually be heavier and coarse. Turns tend to concentrate the dust at the outside. Sampling in a vertical duct, at the end of a long straight section, or at least 10 duct diameters downstream from any turn or obstruction, is preferred. When a compromise location must be used, the number of samples may be increased to improve the quality of the sample. Other factors affecting the number of traverse points are the distribution, duct size, and duct shape.

The sampling device used in the ASME method is shown schematically in Fig. 1. A number of specific designs have been approved and are illustrated in the code. Each consists of a number of basic components that must satisfy the following:

1) There must be a tube or nozzle for insertion into the gas stream through which the sample is withdrawn. This tube or nozzle can be tapered outside, but a rounded leading edge is preferred. The nozzle OD must not be less than ¼ in.

2) A filter or separating device is needed for removing dust from the sampled gas. A 99.0 percent removal of dust from the sample is considered adequate. The filter is preferred to other

means of sample collection. Suggested filter media include paper, cotton, alumina, and glass wool. It is noted that glass wool may contaminate the sample when the sample is freed for analysis.

3) A means for checking the velocity of the gas entering the nozzle must be included in order to obtain the sample under isokinetic conditions. If the sampling velocity varies appreciably[6] from the stream velocity, the sample will not be representative. If the sampling velocity is too low, the dust concentration measured will be too high and an excess of large particles will be collected. If the sampling velocity is too high, the measured dust concentration will be low and an excess of small particles will be collected. A pitot tube attached to the nozzle may be used in conjunction with the nozzle velocity to obtain isokinetic sampling. The sampling rate is adjusted so that the velocity measured in the stream is equal to the nozzle velocity determined from the sampling flow rate and nozzle area. The common method of obtaining equal velocities is to compare static pressure in the nozzle with that in the stream at the point of sampling. Static pressure taps are provided for this purpose and the sampling rate is adjusted to obtain a zero static pressure difference.

4) Provision for measuring the quantity of gas sampled is needed. An orifice meter or a displacement meter is usually used for this purpose.

5) An exhauster is needed to draw the gas through the sampling system.

Some of the data that should be recorded during the sampling procedure include temperature of the gas, time of sampling at each station, carbon dioxide content of the gas in a combustion process, location of probe, and barometric pressure. A data sheet for recording pertinent data is given in the code.

It is evident that the sampling procedure is time-consuming and must be carried out with considerable care to obtain acceptable results. Modifications of this procedure — especially in sampling devices — have been made by a number of investigators. These are reported[1, 2, 7, 8] in the literature along with sampling procedures.

Once the sample has been collected, the dust concentration is calculated from the weight of dust collected and the quantity of gas drawn through the sampling system. The calculations must be properly weighted according to the type of traverse employed. The sample collected is then used for laboratory determination of particle size and chemical properties.

TABLE 1 — APPROXIMATE PARTICLE SIZES correspond to U. S. standard sieve meshes as follows

U. S. standard sieve mesh	Nominal mesh opening, microns
35	500
60	250
100	149
140	105
200	74
325	44

Methods of Measuring Particle Size

A number of methods[9, 10] may be employed to determine particle size. The methods suggested in the code are presented here briefly.

Sieving is one simple means of determining particle size. The dust sample is placed in a nest of graduated sieves which progress from the coarsest to the finest from top to bottom. The dust sample is placed in the top sieve and the sieves are mechanically vibrated. The dust collected on each sieve is weighed to determine the fraction of dust in each particle size range. The sieves used in the code determination are U. S. standard sizes 60, 100, 200, and 325 mesh. The relationship of particle diameters and sieve sizes is given in Table 1.

This method of particle size determination is accurate down to the 200 mesh size. Below this size, properties of fine particles[9], such as electrostatic activity, hygroscopicity (ability to absorb and retain moisture), and tendency to aggregate make sieving determinations unreliable. The results for particles smaller than the 200 mesh sieve size (nominal 74 micron) should be checked by the microscopic or elutriation methods. Since some air pollution control ordinances place restrictions on emissions greater than 44 microns (325 sieve mesh), the latter methods may have to be used when determining compliance.

Microscopic methods require dispersion of a representative sample of the collected dust and some means of making linear measurements of particle size. The particles are all measured in the same direction and care must be taken to obtain a good statistical sample.

Elutriation analysis is accomplished by passing an air stream vertically through the collected sample. The particles are separated into sized fractions by the upward motion of the air stream.

The light fractions are withdrawn first by controlling the velocity in the elutriator. The large particles settle out at low velocities. The settling rate is related to particle size and, by increasing the volume flow or decreasing the diameter of the chamber of the elutriator, successively larger particles are removed. Each fraction is collected and weighed to obtain the particle size distribution.

Sedimentation is also used to determine particle size. This method utilizes the variation of the rate at which particles of different sizes will settle in a liquid or gas. Two new methods have been developed to overcome the length of time required to determine size by the elutriation and sedimentation methods. Research is in progress at Armour Research Foundation under a grant from the Air Pollution Control Association to compare the various methods of measuring particle size. The objective is to eliminate differences in results that are now obtained with the various methods.

What Dust Loadings Are Encountered?

Dust concentrations in industrial exhaust gases vary widely from less than one grain per cu ft to as much as 30 to 40 or more grains per cu ft. Light loadings (less than one grain per cu ft) have been measured in such operations as foundry tumbling and some grinding operations. Concentrations of 30 to 40 grains have been measured in operations such as rock crushing. Coal fired[11] boilers produce fly ash in concentrations from one to 5 grains per cu ft. Boiler design, type of burner, type of coal and operating conditions have an effect on the amount of fly ash leaving the boiler. In pulverized coal fired boilers, 80 to 90 percent by weight of the fly ash is smaller than 44 microns. In other types, such as underfeed and spreader stokers, only half of the particles are smaller than 44 microns. Dust concentrations for many industrial processes have been reported in the literature.[9, 12 13]

Equipment Used to Control Particulate Emissions

The separation of particles suspended in gas streams is accomplished by exerting a force upon the particles that causes them to be deposited upon a collecting surface. A number of mechanisms are used to cause deposition. These are gravitational, inertial, physical or barrier, electrostatic, molecular and diffusional, and thermal or radiant.[4]

These same mechanisms may also be used to modify the properties of the particles to increase the effectiveness of other forms of collection. Examples of this are increasing the size of the particles by condensing water vapor on them or using sonic vibration to cause the fine particles to agglomerate. The electrostatic mechanism is also used to agglomerate fine particles, such as carbon black, which are then collected by other means.

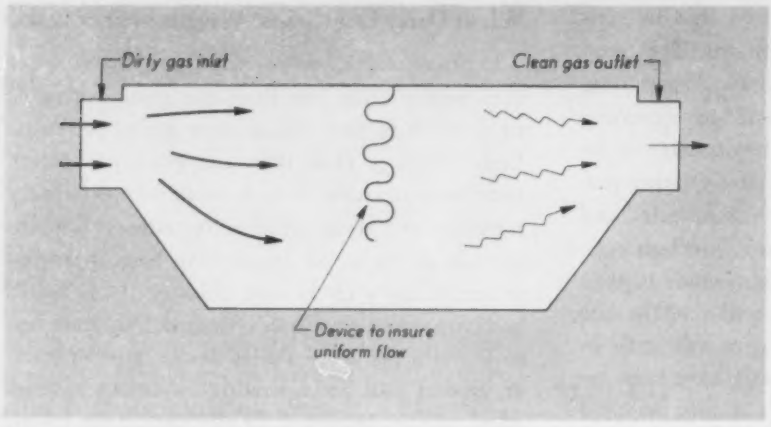
Some of the common types of collectors used in air pollution control and a review of their characteristics and applications are considered here. More detailed information on these collectors is given in References 9, 12, 13, 14 and 15.

Settling Chambers for Large Particles

The gravity settling chamber shown schematically in Fig. 2 is one of the simplest devices used for dust collection. It is most often used to collect particles larger than 40 microns. It is basically an enlargement of the duct carrying the contaminated gas stream. The velocity of the gas is reduced sufficiently in the chamber to permit the particles to settle out by gravity within the limits of the chamber.

A device is often suspended in the chamber to minimize turbulence and to insure uniform velocity in the chamber. Screen, cloth, rods and similar materials have been used for this purpose. If velocities are not uniform throughout the chamber cross section, particles may be carried through the collector by the high velocity portion of the stream. Although higher velocities are used, it is recommended that the gas velocity be less than 60 fpm to prevent re-entrainment[12] of the particles.

The efficiency of the collector depends upon the velocity of the gas stream, the length of the collector, and the velocity with which the particles to be collected will settle. Efficiency increases with length and particle size (large particles settle more rapidly than small particles) and decreases with increased gas velocity. To



2 SETTLING CHAMBERS, illustrated in simple form at the left, use gravity to collect particles. Gas velocity is reduced to permit particles to settle. They are usually used for collecting large particles

increase efficiency for a given physical size of collector, a number of shelves or plates may be installed in the chamber to decrease the effective distance the particles must settle. Although these collectors can be designed for collection of particles smaller than 40 microns, the physical size of the collector sometimes becomes impractical.

Since gravity collection is primarily useful in collecting large particles, it is not widely used as an air pollution control device by itself. It would be effective in eliminating only a local or plant area nuisance since the heavy particles thus collected settle rapidly from the atmosphere. This type of collector has been used in metallurgical processes to collect fumes which tend to flocculate. In some of these applications, the gravity collection chamber[9] is simply an enlarged portion of a long flue connecting the stack and the furnace. Gravity collection is also used in the manufacture of some foodstuffs and powders as a first step in product recovery.

Settling chambers, when properly applied, provide a relatively low cost means of collecting large particles. Maintenance is light and consists of cleaning as required by the particulate collected. Materials used in construction vary with the temperature and corrosiveness of the gas stream. Pressure losses are low and are mainly due to dynamic losses at the inlet and outlet of the chamber.

Centrifugal Collectors Most Common

A number of types of collectors depend upon inertial forces to separate particulates from gases. The simple *cyclone* collector illustrated in Fig. 3 is one such device. In this collector, the gas is given a spiral motion by use of baffles, guide vanes or inlet design. The gas stream carrying the particulates is accelerated as it descends into the separator. Centrifugal force on the particles causes them to move to the cyclone wall and down to the dust outlet. At the bottom of the vortex, the gas stream turns and the clean gas moves axially upward and out of the separator. The inertia of the dust particles causes them to drop out of the gas at the base of the collector.

The effectiveness of cyclones depends upon particle size, particle shape, and the density of the material to be collected. These things affect the terminal velocity of the particles and, thus, affect the inertial forces which cause separation. The total gas flow also influences collector efficiency. Increased flow increases efficiency.

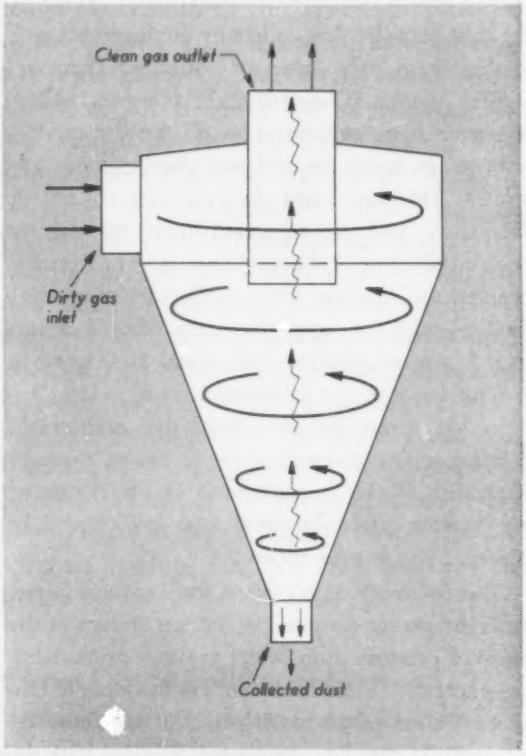
The efficiency of cyclones is reported on the basis of performance tests because it has been impossible to derive generalized formulas for describing their performance. Efficiencies are given as a function of particle size for a given specific gravity, gas temperature and particle shape. In some cases, efficiencies are reported in terms of the terminal velocity of a particle falling freely in air. This latter index combines to some degree the effects of size, shape, and density.

In general, the cyclone collector is considered effective for particles larger than 10 to 20 microns. The reasons for this are apparent when their efficiencies are considered. In most cases, the efficiency of separation will be very high (above 90 percent) for particles larger than 20 microns. Efficiency decreases sharply with decreased particle size and may be as low as 60 to

70 percent for particles about 5 microns in diameter with well designed high efficiency cyclones and even lower for other designs.

Cyclones are made in a number of sizes and designs to improve the effectiveness of collecting small particulates. Two general classes are the low pressure drop cyclones similar in design to that shown in Fig. 3 and the small diameter or tubular designs, which are considered high efficiency collectors. The latter designs have high pressure drops and often consist of a number of tubes installed in parallel in a casing. These generally require less space than the large diameter cyclones for the same volume flow and efficiency. The tube inlets are designed to provide the necessary whirl and they operate at higher velocities. The inlet to the multiple cyclone assembly must be carefully designed to insure uniform distribution through the many small tubes.

The pressure loss in cyclone separators consists of dynamic entrance and exit losses, rotational losses at the outlet, and friction loss at the walls.



3 CYCLONE COLLECTOR, shown above, is one of several types that employ inertia of the dust particles to separate them from a gas stream. A conical cyclone is shown but they are also made in cylindrical form. Other collectors that utilize inertia include the mechanical-centrifugal separators, impingement separators, and packed beds

Pressure loss varies from one to [illegible] velocity heads based upon inlet velocity.

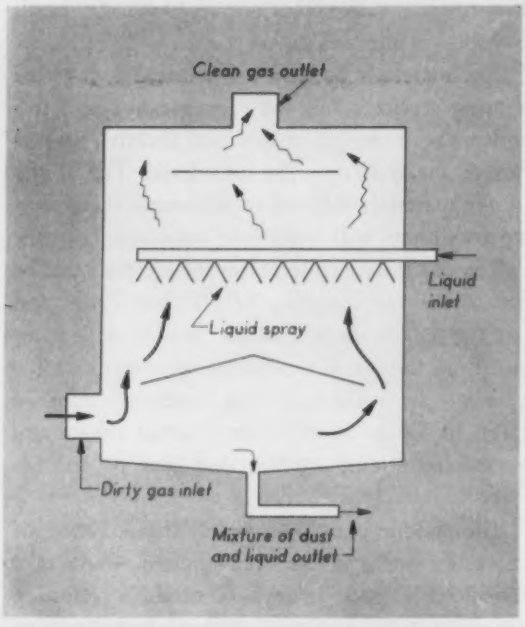
The materials used in cons[illegible] are varied to meet service conditions. Temp[illegible] and corrosiveness of the gas stream and abr[illegible] properties of the dust must be considere[illegible] ability of the materials selected to withstand these service conditions will determine maintenance costs.

The particulate collected in the cyclone must be dry to prevent plugging of the dust outlet and loss of effectiveness. Similar results will occur any time dust is permitted to accumulate at the base of the collector. Thus, attention must be given to design of the dust removal system and variations in dust loading that may be encountered.

The cyclone is used so widely that a listing of processes where it has been applied would take considerable space. It has been used for collecting emissions from coal-fired boilers, rock crushing and grinding, manufacture of drugs and foodstuffs, for sintering plants, woodworking and metal surfacing exhaust systems, and for many other applications. It is often used as a precleaner in series with collectors which are more efficient on fine particles. Mechanical-electrical collectors for fly ash are typical of this type installation.

Mechanical-centrifugal separators operate on the same principle as cyclones except that an integral fan or rotating member provides the necessary centrifugal force for separation. In some cases, the unit is designed to operate as a fan as well as a dust separator. With some types of materials — those which will deposit on the blades — the maintenance of this type of collector may be high due to unbalancing of the rotor. The efficiencies are in the same range as those for small diameter cyclones and they are used for similar applications. For the same capacity they generally occupy less space than an equivalent cyclone.

The *impingement separator* is an inertial device in which the unwanted particulate is deposited on plates or packing as the gas passes around them. The baffle surfaces are sometimes wetted to aid in removing the collected particulates. These separators are effective on particles larger than 20 microns. They are used as cinder traps for stoker fired furnaces and for separating entrained liquids from gases. The pressure losses vary with the type of baffling, the spacing, gas velocity, etc.



4 SPRAY WASHERS, illustrated here, employ a liquid — usually water — to separate particulates from gas streams. Many types of wet collectors are available. Some combine inertia and wet principles, others use expansion of the gas stream in venturi nozzles to obtain intimate mixing of liquid and particles. Corrosion and disposal of the slurry must be considered in wet type collectors

Packed beds, in which the particulate laden gas stream is passed through a layer of packing, utilize impingement as well as other mechanisms for collecting the particles. The packing may consist of sand, gravel, coke, or fibrous materials such as mineral wool and steel wool. The bed depth varies with the packing used. The gas velocities are maintained at relatively low values (1 to 50 fpm for coarse packing and 1 to 15 fpm for fine packing). Efficiencies may approach 100 percent when densely packed fine materials are used.

When the dust concentration is high, provision must be made to replace the packing at regular intervals to maintain reasonable pressure drops and constant gas flow. Recent developments[16] indicate that packed beds of mineral fibers show promise in the simultaneous collection of acid gases, mists, and fumes as well as particulates. By keeping the fibers wet, the efficiency of collecting acid gases is improved. It should be noted that the acid gases are collected through chemical reaction with the mineral fibers. The mineral wool is depleted and means are required to recharge the bed. Methods of recharging the packing in packed beds of this type have been studied in a pilot installation. Results indicate that a considerable amount of development is required before the process can be made practical for a full scale collector.

Use of Scrubbers and Washers

A wide variety of scrubbers and washers is available and many new applications are being made. Scrubbers have in common the use of a liquid — usually water — to aid in collection of particulates. The methods of bringing the liquid and particulate into intimate contact vary from the simple spray chamber, as shown in Fig. 4, through high pressure loss venturi scrubbers. In some cases, the gas stream is bubbled through a liquid bath. The water serves different functions[17] in the various scrubbers. In some, such as the spray chamber and the venturi scrubbers, the water droplets serve as targets on which the dust particles collect by impaction. In others, such as the wet mechanical-centrifugal collectors and packed towers or baffle chambers, the water holds the dust particles that collect by impingement and washes them to a sump or collecting chamber.

Wet mechanical-centrifugal collectors utilize the same basic equipment as do the dry models with water being sprayed into the incoming gas stream. The water and dust particles collect on the wheel and are separated from the gas by centrifugal force. The collected material is discharged as a sludge. Other collectors using centrifugal force for separation are similar in design to the cyclone collector, with water introduced in the vortex or in the incoming stream.

In the atomizing scrubbers, the gas stream carrying mists or particulates is passed through a venturi. Water is introduced at the throat of the venturi, and impaction and collection take place as the stream expands.

The efficiency of scrubbers and washers varies with the power supplied to the gas stream in the form of pressure drop, water pressure or mechanical energy[4,18]. Plain scrubbers are moderately efficient. Values of 70 to 90 per cent have been reported[18]. Higher efficiencies are obtained with the wet mechanical-centrifugal collectors. Efficiencies of 75 percent on particles as small as 1 to 2 microns have been reported.[19] Average field efficiencies of 97 to 99 percent[18] have been measured.

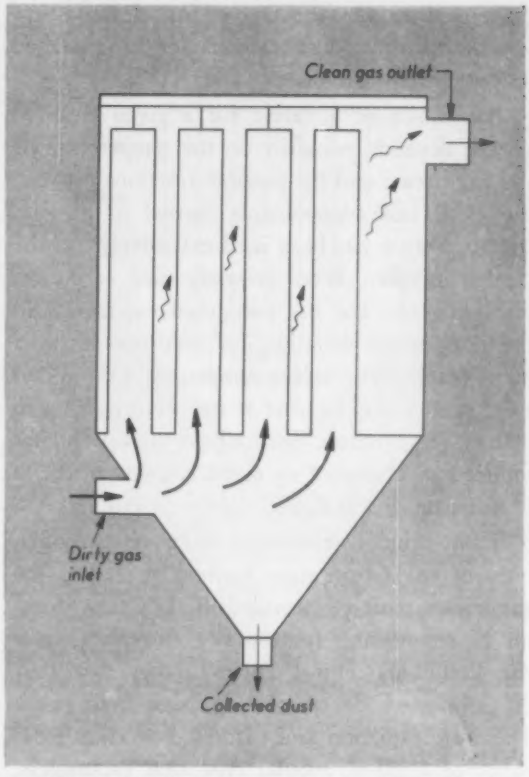
To avoid a spray nuisance with wet collectors, some sort of entrainment baffling must be installed in the gas outlet. Carryover may also cause maintenance problems. An example of this was recently reported[20] in which scrubbers having pressure drops of 45 in. of water perform satisfactorily with efficiencies of 90 percent. However, many of the small uncollected particles are deposited on fan blades, thus causing unbalance. Frequent shutdowns are required to clean the blades. Since these are used in a chemical process, this maintenance is expensive as the process must also be shut down. Corrosion may also cause excessive maintenance when acid mists are collected by this means.

Wet collectors, in addition to being widely used in chemical plants, have recently been applied for air pollution control in iron and steel plants[21] for collecting emissions from sinter plants, bessemer converters, basic oxygen plants and coal pulverizers. They have been used for some time in steel plants to clean blast furnace gas. In this application, they serve the dual function of cleaning the exhaust gas for use as a fuel elsewhere in the plant and of air pollution control. A full scale pilot model high energy scrubber (about 700 hp for a 200 ton furnace) has been installed on an open hearth furnace. Wet collectors are also used on asphalt concrete batching plants[22] and municipal incinerators.[8]

Wet collectors have the advantage of operating without difficulty over a wide range of temperatures, since the water cools the gas stream. However, the leaving air is generally saturated and the condensing vapors may cause a white plume. This is usually not considered a nuisance. But when large volumes of gas are cleaned, the plume may cause bad psychological effects. Attention must be given to disposal of the sludge or waste water withdrawn from these collectors to avoid a water pollution problem. And they must be located to prevent freezing in cold climates.

Where Fabric Collectors Are Used

Fabric collectors are often used for collecting dry particulates where high efficiencies are required at high dust loadings. The fabric is placed in the collector in a number of ways, including the commonly used inverted tubes as illustrated in Fig. 5. Other forms in which the fabric is used



5 FABRIC COLLECTORS employ the cloth media in a number of ways, such as in bag form as shown above. Other forms are the multiple bag or envelope type, and the leaf type. Fabric collectors have high efficiencies and can handle high dust loadings. Dust that is collected on the cloth is removed by periodic shaking of the bags or by reversing the gas flow and blowing the particles from the fabric

are multiple bags or envelopes and a leaf type arrangement in which the cloth is wrapped over supporting frames. Because of the commonly used tube or bag, these collectors are often called "baghouses." Fabrics that have been employed include cotton; wool; many of the synthetic fabrics such as dacron, orlon and nylon; and a siliconized glass cloth.

In the fabric collector, dust first collects on the surface of the cloth by impaction or some other mechanism. The deposited dust then builds up on the surface of the fabric, and this layer of dust acts as a packed bed and increases the efficiency of the collector. The high efficiencies of these collectors, which approach[12] 100 percent with particles as small as 1 micron and 90 to 95 percent with particles less than one micron, depend upon the collection of the dust layer. Thus, with present fabrics, high dust loading is desirable though not necessary for satisfactory performance. Methods of initially coating the surface of the cloth to

make the baghouse suitable for cleaning gas streams with low dust loadings are being studied and some show promise.

The choice of a fabric for a given cleaning service depends primarily on the temperature of the gas stream and the possible reactions between the cloth and contaminants carried in the gas stream. Cotton has been used extensively[28] in the cement industry. Wool is rarely used in the cement industry, but has been used extensively in the non-ferrous metallurgical industries because of its resistance to sulfur compounds. Cotton and wool fabrics may be used at temperatures[12] up to 200 F. The synthetic fabrics have slightly higher service temperatures[28] — nylon is used up to 200 F, orlon up to 250 F, and dacron to 350 F.

If the effluent temperature is above the limitations of any fabric, some method of cooling the gas stream must be provided. R. L. Chass, director of engineering for the Los Angeles County Air Pollution Control District notes that four different methods of cooling have been used. These are radiation and natural convection from banks of U-tubes; tubular type heat exchangers, water cooled or forced air cooled; direct cooling by water evaporation in spray chambers; and dilution with atmospheric air. Care must be taken to be sure the effluent temperature is considerably above the dew point to prevent condensation in the baghouse and resultant failure.

A new fabric for these collectors is silicon coated glass cloth, which has been used with success[28] at 550 F. The ability of this fabric to withstand high temperatures makes the use of the baghouse promising[21] for the collection of fumes from furnaces in the iron and steel industry. Because of the low temperature limits of other fabrics, they have been used in limited numbers in this industry. The large amount of dilution air needed to reduce the gas temperature to allowable values requires the use of an excessively large baghouse. Design gas velocities through the fabric of 2 to 3 fpm are often used. Another feature of the silicon treated glass cloth is that it easily sheds the dust layer. Cleaning can be accomplished[28] by allowing the bag to flex. Thus, the need for shaking is eliminated. This prolongs the life of the cloth and decreases maintenance costs.

The removal of dust from the fabric may be difficult in some cases. Since the dust layer collected on the fabric increases the pressure loss through the collector, some means must be provided for periodically cleaning the cloth. In the tube and envelope collectors, the dust laden gas stream enters from the bottom, is cleaned, and passes out near the top of the collector. The dust is collected on the inside of the tubes and is removed by shaking or vibrating. In some cases, provision is made to reverse the gas flow in the collector, and atmospheric air is used to blow the dust from the fabric. In the leaf type collector, air enters from the top and is discharged near the bottom of the unit. Dust collects on the outside of the leaf and is removed by shaking or blowing.

Cleaning may be accomplished automatically so that gas may be continuously passed through the collector. For example, in the reverse-jet fabric collector, continuous cleaning is accomplished by a high speed air jet which continuously traverses the cloth. Because of continuous cleaning, gas velocities of 10 fpm and higher can be used, thus, permitting the use of a smaller collector. Cleaning may also be done intermittently when it is possible to shut down the exhaust system for short periods.

Preventive maintenance has been found[28] important to the continued satisfactory performance of baghouses in the cement industry. Keeping the shaking mechanism clean so that it functions properly adds to the life of the fabric. An excessive layer of dust on the cloth impairs operation and leads to early failure of the cloth. It has been found that replacement of all bags when a unit is shut down for service is more economical than replacing individual bags. This permits careful repair of the bags, which may then be installed at the next maintenance shutdown.

In cold climates, it is necessary to consider the possibility of condensation and possible ice formation on the fabric. Either of these may lead to plugging of the fabric[24] and failure of the system.

Baghouses have been used extensively for the collection of fumes from non-ferrous metallurgical operations,[22] for the collection of dust from mineral insulation production processes,[22] in the cement industry[23], and in the chemical industry[20]. They have also been used to collect emissions from plants employing asphalt as a basic material, such as a roofing paper saturating plant[22]

and asphaltic concrete batching plants[24]. In the latter case, a water sprayed coarse fabric appears to withstand the rough service satisfactorily.

Electrical Collectors Widely Applied

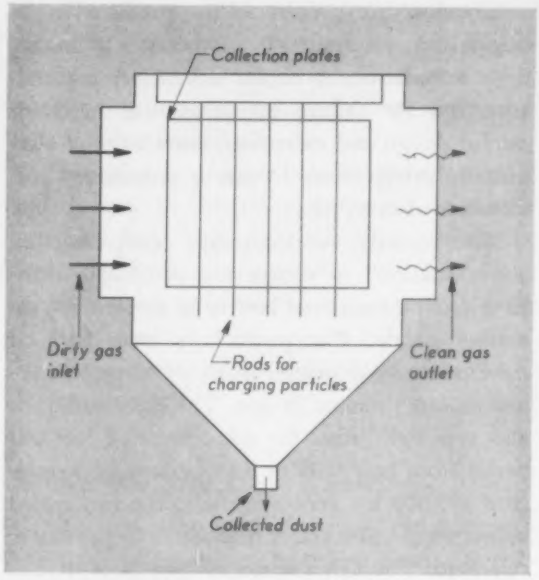
In the electrostatic precipitator, the particulate to be collected is given an electrical charge and caused to migrate to a collecting surface upon which an opposite charge is maintained. Precipitators are made in two basic types. In the industrial collector, illustrated schematically in Fig. 6, the ionization and collection take place simultaneously. Direct current voltages of 30,000 to 100,000 volts are employed, with the ionization wires or discharge electrodes as one pole and the collecting plates as the other. The collecting plates are always grounded as is the casing to eliminate any electrical hazard. The discharge electrodes are suspended from electrical insulators. A discharge takes place between the two electrodes, which sets up the necessary electrical field for collection of the particles.

In the air cleaning precipitator commonly used in air conditioning systems, a two stage charging and collecting arrangement is used. The air stream passes first through an ionizing chamber and then into a collecting chamber. Collection takes place on a group of closely spaced plates. Direct current voltages of 5000 to 13,000 volts are employed in these precipitators.

The charge on the particulates is dissipated upon collection. Several processes may be used to remove the deposited particles from the collecting surface. These include washing, vibrating or, in some cases, continuous dipping of the plates. Liquid particulates drain by gravity from the collecting surface.

The precipitator is a high efficiency collector and is capable of high efficiency operation, when properly designed, for widely different services. Efficiencies approaching 100 percent are not uncommon and reported values for most services range from 85 to 99 percent. They can collect submicron size particles with nearly the same ability as particles as large as 100 microns.

Some of the important[25] factors governing efficiency include: 1) The electrical resistivity of the gas and of the particles in the gas stream, (2) the gas velocity, (3) the concentration of suspended matter in the gas stream, (4) the particle size, and (5) the degree of cleanliness of the discharge and collecting surfaces. Other factors that must be considered include temperature and humidity.



6 ELECTROSTATIC PRECIPITATOR illustrated above collects particles by giving them an electric charge that causes them to migrate to collecting surfaces where they are deposited. Collecting surface may be a plate as shown here or may be pipes. Efficiency is high even on submicron size particles. Solid particles are removed from the surface by rapping or washing. Liquids drain from the surface by gravity

Two applications made recently illustrate the adaptability of the precipitator to cleaning vastly different gas streams.

Electrostatic precipitators have been used to clean the effluent from open hearth furnaces. Gases leave the open hearth[21] at 1600 F but are reduced to 500 to 600 F by waste heat boilers. The dust is of very small size with more than half of it less than one micron and a large part of that as small as 0.03 microns in size. The dust loading varies[25] with each portion of the cycle of furnace operation. During the normal melting operation, the loading on one such installation was 0.8 grains per cu ft, while during the blowing of the checkers the dust loading was about 5 grains per cu ft. The volume of gas cleaned was 75,000 cfm and the reported efficiency was 98 percent. Although this installation was successful, subsequent installations on several similar furnaces failed to perform as expected because of changes in the process. One factor contributing to the unsatisfactory performance of these collectors was a gas

volume flow rate in excess of that predicted in the original furnace design. It was possible to modify these installations to obtain satisfactory performance, but the failure emphasizes the need for careful design and more basic knowledge of electrostatic precipitation to assure satisfactory performance of every job.

More recently, an electrostatic precipitator has been installed[26] to collect the particulate emissions from the oil-fired boilers of an electric generating station. The particulates from fuel oil combustion are extremely small — 90 percent are less than 0.5 micron in size. The dust loading is also very light, since the ash content of fuel oils varies from only 0.05 to 0.15 percent by weight. In a 175,000 kw generating unit, the anticipated collection of particulates is about 75 lb per day at full load. Through the use of two pilot models employing different principles, it was possible to design a full scale collector with an anticipated efficiency of 90 percent. As a result of the initial study, several design modifications were found necessary. The insulator compartments were made more elaborate than those used in the collection of fly ash from coal burning furnaces because of increased insulator fouling. The dust collection and hopper systems were changed because of the lower dust loading and the nature of the dust.

Combination mechanical-electrical collectors have been used extensively to collect fly ash from pulverized coal fired boilers. The centrifugal collectors[27] usually precede the electrostatic collectors and remove the larger fly ash particles. A high concentration of small particles is then delivered to the electrostatic collector. Reported overall efficiencies of the combined units for this service range from 90 to 99 percent.

Representative dust loadings and efficiencies provided[5] by J. H. Carter for electrical precipitators and combined mechanical-electrical collectors for collecting fly ash from pulverized coal fired boilers are listed in Table 2. These include systems in which electrical precipitators have been added to mechanical collectors (installations 1 and 2) and a new combined mechanical-electrical collector (installation 3). The leaving dust loading was also provided for another new mechanical-electrical set-up. For three tests, the dust loading averaged 0.544 lb dust per 1000 lb flue gas. These values are within local code requirements

TABLE 2 — FIELD MEASURED DUST-LOADINGS AND EFFICIENCIES of electrical precipitators in mechanical-electrical dust collection systems for collecting fly ash from pulverized coal fired boilers are given here

Installation	Collector	Dust loading, lb dust per 1000 lb flue gas[a]		Efficiency, percent
		Entering	Leaving	
1	1	5.61	0.29	95.2
	2	2.86	0.076	97.5
	3[b]	3.68	0.64	82.5
2[c]	1	5.44	0.27	95.1
	1	6.56	0.107	98.3
3[d]	1	5.97	0.137	97.6
	1	5.76	0.138	97.5

a. Dust loadings based upon tests made in accordance with ASME Power Test Code 21. Values reported are corrected to 50 percent excess air.
b. Load fluctuated by as much as 20 percent during test. Suggests that fluctuating load may adversely affect performance of the dust collection system (distribution of gas flow to the collector, gas volume, etc.) or the method of measurement.
c. Two acceptance tests were run on this collector after the precipitator was installed. In the second test the mechanical collectors, which were about 18 years old, appeared to be inoperative.
d. These tests include combined performance of a new mechanical-electrical collector. The two collectors in series are in a single unit so that the entering dust loading is that for the combination. Reproducibility of test results when procedures are carefully followed is indicated by these tests made on different days.

but Mr. Carter noted they were disappointingly high. He attributed the low efficiency to the tortuous path the ductwork had to follow because of space limitations. Gas distribution through the collector was not uniform and one side of the collector did most of the cleaning.

Electrical precipitators have been used for air pollution control in many other applications. Some of the other industries that have used them for minimizing air pollution are oil, non-ferrous metallurgy, cement, chemical, and paper.

Electrical precipitators are relatively expensive in first cost but have relatively low maintenance and operating costs. The maintenance required is that associated with electronic equipment. Keeping discharge and collecting electrodes and insulators clean may be a problem with some pollutants. In addition to their high efficiencies, the electrical collectors have desirable low pressure losses. Velocities through the collector are maintained at low values to provide sufficient treating time. Thus, pressure losses are only a few tenths of an inch of water.

Where Are Air Filters Used?

Air filters, which are similar in operation in many respects to the cloth collectors, are sometimes used in the control of atmospheric pollution. They are generally satisfactory for cleaning large volumes of gas carrying very light dust concentrations. Some, such as the viscous self clean-

ing type, may be used at high concentrations. Filter media may include wool, asbestos, cellulose, glass or metal fibers. They are most often used for collection of solid particulates but in some cases are used for the collection of mists. Dust loadings for which filters are generally used range from 0.0002 to 0.01 grains per cu ft.

The efficiency of a filter depends upon the size of the media fibers and the density with which the fibers are packed in the filter mat. Efficiencies many range in different applications from 40 percent for dry types with normal atmospheric dust concentrations and particle sizes to almost 100 percent for special types.

Two examples of the use of filters for control of atmospheric pollution should be noted. Two ply paper type cellulose tissue has been used to effectively[28] collect ink mists released from high speed printing operations. Large volumes of air are used to ventilate such pressrooms to prevent escape of ink to other sections of the building. To prevent soiling of neighboring structures, the ink mist must be collected from the exhausted ventilation air. With the two ply media, weight collection efficiencies of 98 percent have been achieved. Suggested design criteria and considerations are given in reference 28.

Another use of filters for control of air pollution is found in the cleaning of ventilation exhaust effluents in laboratories or process plants having radiological hazards. Special types of filters are usually a necessity for this service because of the nature of the pollutant. Pleated asbestos type paper filters have been used with success.[29] Also, filters employing special fine glass fiber media and packed beds of graded sand have been used with satisfactory results.

Maintenance of air filters depends upon the dust loading and the type of filter used. The need for cleaning or replacement is based upon the permissible increase in pressure loss for a given system.

Sonic and Thermal Collection

Other means of collecting particulates that should be mentioned are the sonic and thermal methods of precipitation. By means of acoustic vibrations imparted to a gas stream, fine particles can be made to collide and aggregate into larger particles. These larger particles can then be collected by conventional means. Because of high energy requirements, this method of agglomeration is in but limited use.

Thermal precipitation is used for collection of atmospheric particulate samples for laboratory analyses. Particles migrate toward a cold surface and away from a heated surface due to the temperature gradient in the gas stream. As in the case of sonic vibration, there appears to be little promise of application of this principle of collection to large scale service.

What We Need to Know

Although many successful applications of various types of equipment have been made for control of particulate emissions, much information is needed to provide economical solutions for impending air pollution problems. The state of the art and the information needed are clearly outlined by the following technical areas requiring furthur investigation as stated[30] by Dr. Leslie Silverman at the National Conference on Air Pollution:

"New methods for handling fine metallurgical process fumes at high temperatures.

"Methods for controlling acid mists and complex high vapor-pressure organic suspensoids.

"Continued studies on fundamental particle dynamics as applied to inertial separation, filtration, and electrostatic properties of particulates.

"Continued investigations of the photochemical stability and physical chemistry of aerosols.

"Fundamental studies on fixed and dynamic filters, with particular reference to life studies with a wide variety of aerosols.

"Further studies on graded filter media for low loadings of air contaminants.

"The development of temperature-resistant fabrics able to withstand 500 to 1000 F and still perform effectively as filter media.

"Development of relationships from particle and equipment parameters which will enable the reliable prediction of performance from primary dimensions and rapidly evaluated properties of the particulate material."

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27) Schick, D. F., Jr., "Fly-Ash Abatement in the Philadelphia Electric Company System," Journal of the Franklin Institute, Monograph No. 4, 93-97 (1958).
28) May, J. W., "Solving the Ink Mist Problem in Newspaper Pressrooms with Automatic Air Filters," Heating, Piping & Air Conditioning, Vol. 27, No. 5, 120-122 (1955).
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Giant Computers are made here where Employees **THINK**

and work better in air conditioned spaces

INTERNATIONAL BUSINESS MACHINES CORP. MILITARY PRODUCTS PLANT, KINGSTON, N. Y.

Architect: L. Rossetti • Engineers: R. F. Giffels and V. E. Vallet, Detroit, Mich.
Contractors for heating and air conditioning: Rowland Tompkins & Sons, Hawthorne, N. Y.
Subcontractor: Carrier Corp., New York City

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In this big modern IBM plant are produced the world's largest electronic digital computers, which mastermind the famous SAGE Air Defense System.

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Powers Process Controls also are used at IBM for regulating temperature of dryers, metal plating and finishing, photo film developing, heat treating, and shower baths.

Are You Planning a New Building or modernizing an old one? Solving the many temperature, humidity and pressure control problems at IBM exemplifies the engineering skill available at Powers and the versatility of Powers Control to handle a wide range of requirements. Ask your architect or engineer to include a Powers Quality System of Temperature and Humidity control.

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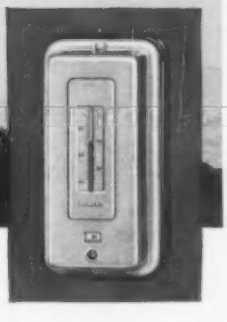

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POWERS CONTROL

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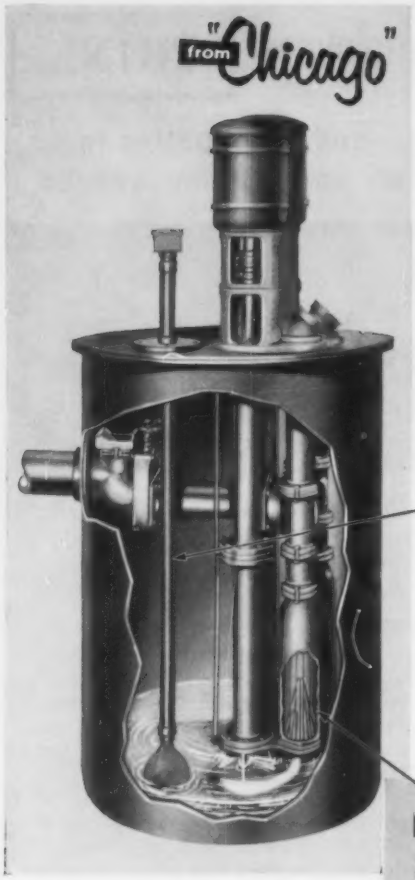
65 years of Automatic Temperature and Humidity Control

Focal point of the SAGE Air Defense System is the round scope portion of Display Console shown in photo below at left. It can depict the over-all battle or focus on part of it. Some of the many spaces regulated by Powers Temperature and Humidity Control are shown here.

"from Chicago"



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better than ever FLUSH KLEEN® clog-proof sewage pumping

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New SEALTRODE*

Sealed Electrode Floatless Pump Controller . . . the *only* pump controller *completely* free of becoming insulated or coated with grease or corrosive elements found in sewage and drainage water.

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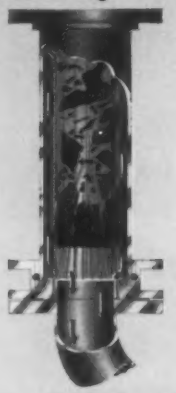
. . . the heart of the FLUSH KLEEN® System, is now available with FLUSH KLEEN® Sewage Pumps. Clear liquid flows continuously around and through the strainer without obstruction . . . at maximum solids loading.



High Wet Strength Paper Products and other solids . . . are never a problem.

Other Features

- Pumps handle clear liquid only
- Dependable, trouble-free pumping performance
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- Longer pump life

OVER 13,000 FLUSH KLEEN® INSTALLATIONS

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Chicago Pump Company

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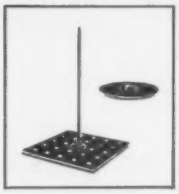

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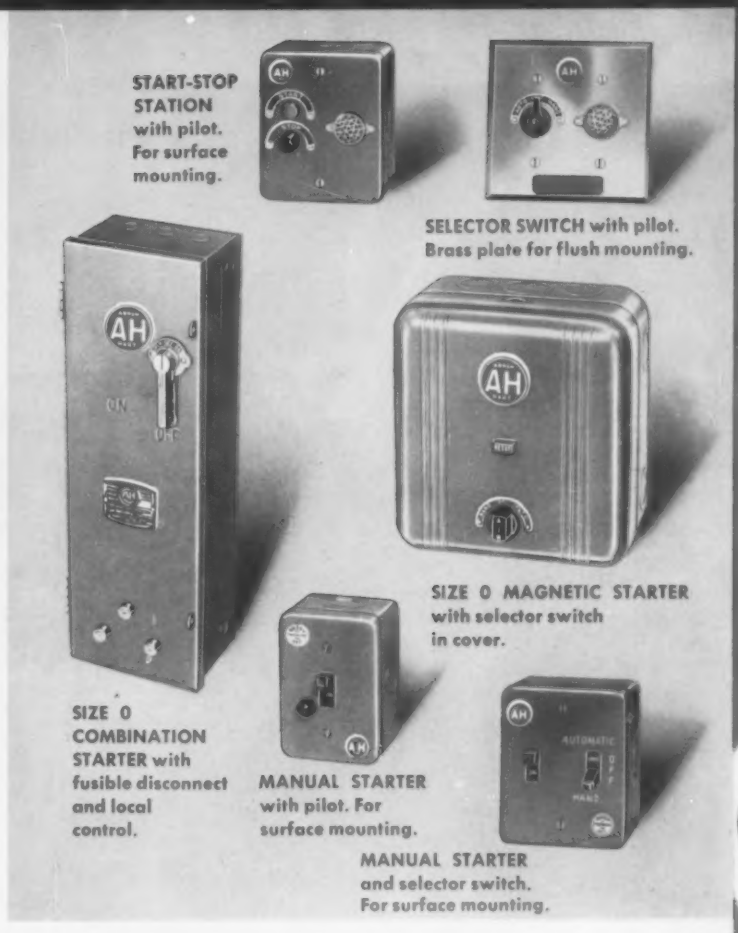
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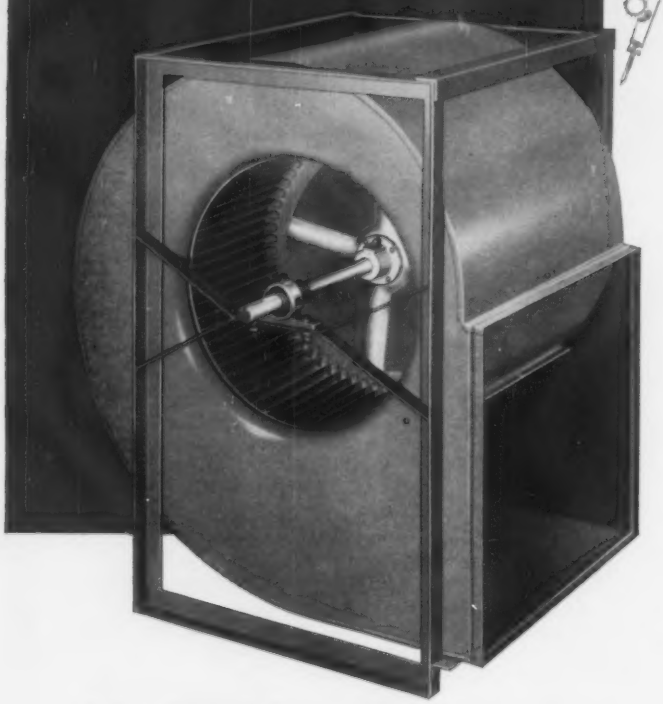

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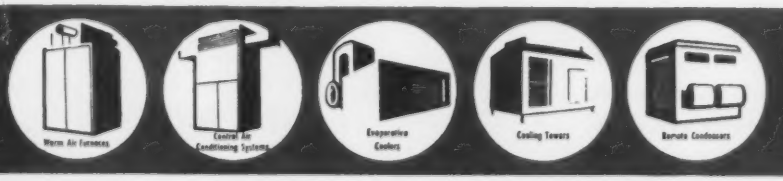

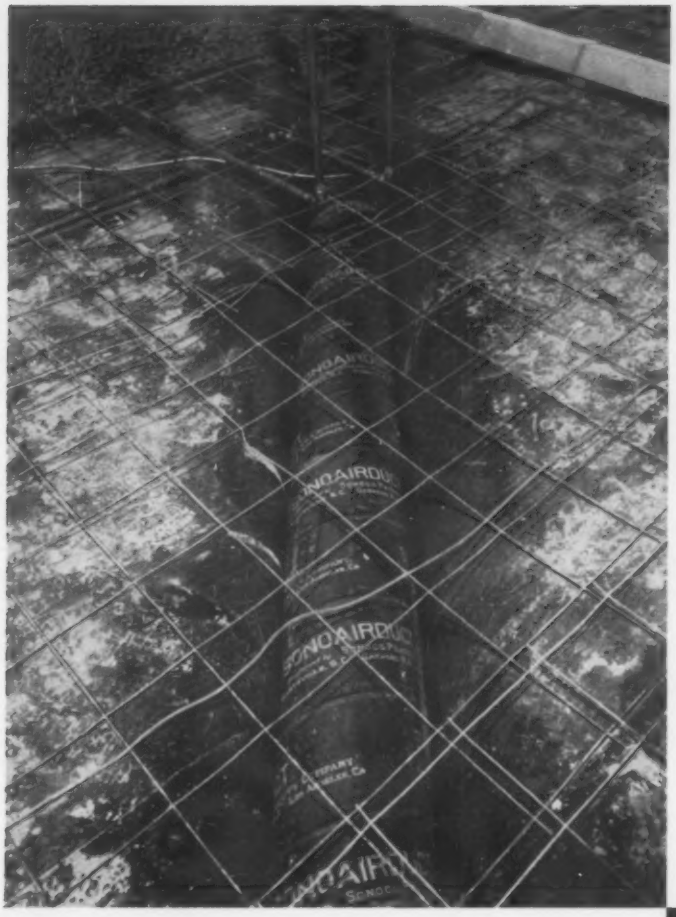

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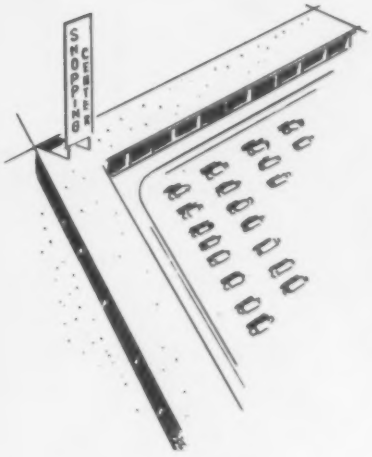

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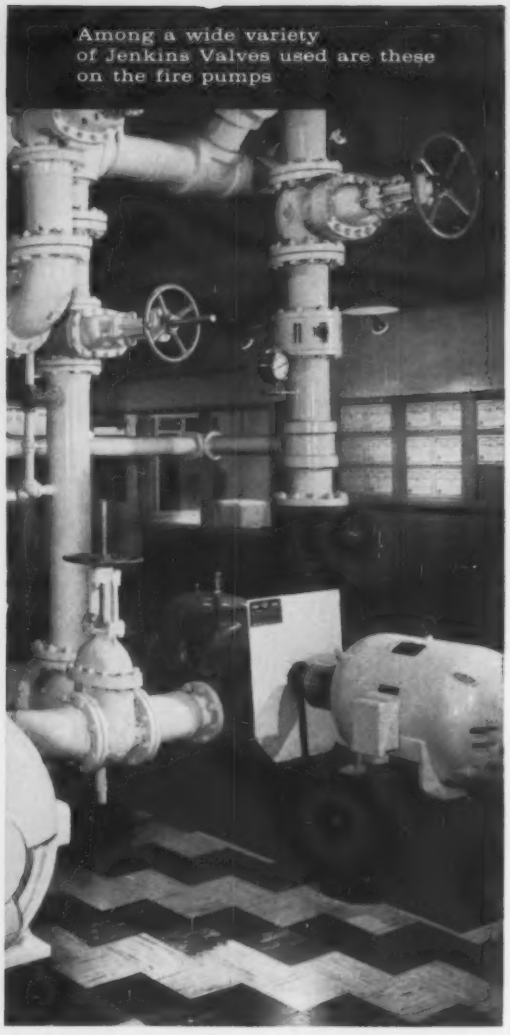

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Mid-America Home Office of **The Prudential Insurance Company of America** relies on JENKINS VALVES

Well-known for careful selection of investments and concern about controllable operating expenses, The Prudential Insurance Company of America sought the soundest of values when building its new 40 million dollar Mid-America Home Office building.

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It is protection that can save money for any plant or building. And, you can specify or install Jenkins Valves knowing they cost no more. Jenkins Bros., 100 Park Avenue, New York 17.

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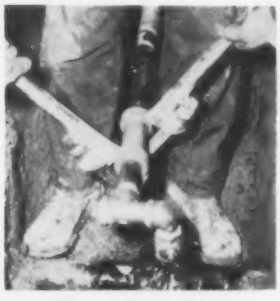
EQUIPMENT DEVELOPMENTS . . .

For reviews of Recent Trade Literature see page 196

Unit Heaters . . .

. . . designed for low noise level applications—*Ilg Electric Ventilating Co., Dept. HPAC, 2850 N. Pulaski Rd., Chicago* 41.

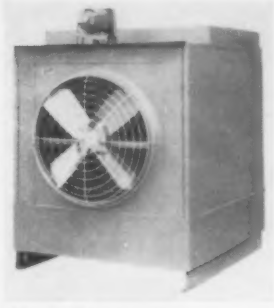
Unit heaters available in eight sizes in capacities from 50,000 to 250,000 Btu per hr input. Blower, motor, and burners designed for quiet operation. Blower is forward-curve, double-inlet type; fan wheels dynamically balanced; motors resilient-mounted on cushion base, and have automatic reset thermal overload protection. Burners are drilled, raised-port type. Heater casing constructed of die-formed, heavy gage steel with integral, aluminized heat exchanger.



Plastic Pipe Coupling . . .

. . . developed to prevent corrosion caused by flow of stray currents at natural gas piping service connections—*Tube Turns Plastics, Inc., Dept. HPAC, 2929 Magazine St., Louisville* 11, *Ky.*

Fitting is insulating connection of inert, non-conducting, high-impact, unplasticized polyvinyl chloride. Has rubber gaskets to grip metal pipe ends when coupling is tightened; and sliding "spacer ring" to keep pipe ends from making contact inside coupler. Fitting measures 6 in. end-to-end, made to fit over 1¼ in. IPS metallic pipe; measures 4½ in. between rubber gaskets, enabling gaps from ½ to several inches to be bridged.



Cooling Towers . . .

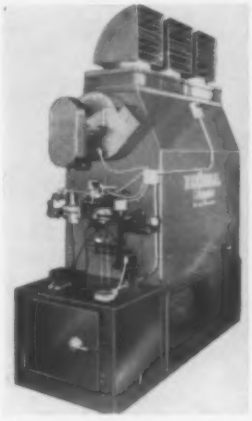
. . . for use with big building air conditioning systems, and for process water applications—*Mason Products, Inc., Dept. HPAC, 9 Crane Ct., Woburn, Mass.*

"Series 3200 Hydra-Glide" packaged, induced draft water cooling towers designed to provide large cooling capacity in small space. "Model 3208" has 7.5 ton capacity at 78 F wet bulb temperature, and is 30 in. wide, 45 in. long, 54 in. high. Available in all steel construction with plastic base coating or stainless steel. All have heart-grade redwood filling, stainless steel fan shaft and venturi-type fan throat. Capacity range is from 5 to 60 tons.

Direct-Fired Heater . . .

. . . with draft-induced, combination fuel burner — *National Heater Co., Dept. HPAC, 2742 Doswell, St. Paul* 8, *Minn.*

"Model CI" direct-fired heaters available in 14 sizes with outputs from 400,000 to 3,500,000 Btu per hr. Burner, designed for heater, uses



gas, oil, or combination gas and oil fuels. Features cited: belt driven induced draft fan for maximum draft adjustment; standardized controls; separate motor compartment for easier lubrication, adjustment; heat, corrosion resistant metals used throughout heat exchanger unit.

Controlled Volume Pump .

. . . designed to move corrosive and heavily concentrated slurries—*Milton Roy Co., Dept. HPAC, 1300 E. Mermaid Lane, Philadelphia* 18.

Pump said to be capable of handling abrasive slurries containing 60 percent solids at pressures to 90 psi. Pump consists of two hemispheres clamped together with slack diaphragm between. Lower hemisphere equipped with inlet and outlet check valves. Upper hemisphere connected to air supply by three-way solenoid valve operated by electric timer. Flow can be varied from zero to 180 gph. Stroke length can be regulated by electric probe mechanism.

Cyclone Dust Separator . . .

. . . with adjustable drive belt to provide wide range of air flow rates against varying resistances — *Torit Mfg. Co., Dept HPAC, Walnut and Exchange Sts., St. Paul, Minn.*

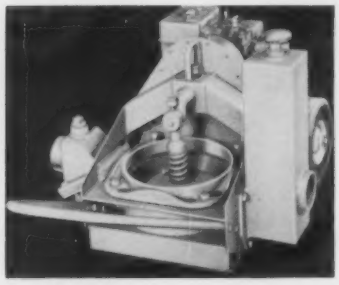
EQUIPMENT DEVELOPMENTS
Continued

"Model 30" cyclone includes radial blower on "clean air" side. Long tapering cone said to provide high efficiency operation. Units, designed for outdoor exhaust, operate in following ranges: 3000 to 4500 cfm; inlet velocity, 3850 to 5800 fpm; static pressure, 7.6 to 12.6 in. WG. "Model 30" is 12 ft, 10 in. high, and occupies 30 × 36 in. of floor space. Inlet diameter is 12 in., outlet 14 in. Equipped with magnetic starter and 10 hp, 3530 rpm, 220/440 volt, 60 cycle, 3 phase vertical motor.

PVC Lined Pipe Fittings . . .

. . . available in malleable iron or aluminum — *Victaulic Co. of America, Dept. HPAC, P. O. Box* 509, *Elizabeth, N. J.*

"Plastisol" pipe fittings have grooved ends for quick-jointing pipe with mechanical couplings. Available in elbows, tees, reducing tees, reducers, caps, and adapter nipples in sizes from 1¼ through 12 in. diam. Fittings have full flow radii. Plastic rubber seamless lining applied by dipping, is uniformly ⅛ in. thick. Designed for handling slurries and abrasive solids in suspension at pressures to 1000 psi. Resistant to numerous acids, alkalies, salts, plating solutions, organic, and miscellaneous reagents.



Diaphragm Pumps . . .

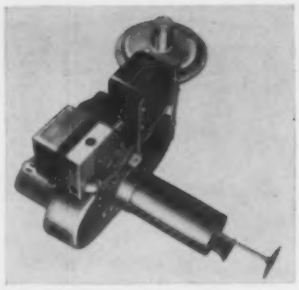
. . . in redesigned and expanded line —*Barnes Mfg. Co., Dept. HPAC, Mansfield, Ohio.*

New line of pumps offers capacities from 3500 to 6000 gph at 5 ft lifts in size range from 1½ to 4 in. Features cited: rubber-faced flap valves and replaceable discharge valve seats; threaded suction connections; replaceable diaphragm; pump shafts, plunger eccentrics equipped with anti-friction roller bearings; discharge valve fitted with bottom cleanout plate; air chamber with threaded top opening for discharging or wetting discharge valve.

Pressure Regulator . . .

. . . redesigned to provide minimum maintenance, tight shutoff, more accurate regulation — *OPW Corp., Div. of Jordan Corp., Dept. HPAC,* 6013 *Wiehe Rd., Cincinnati* 13, *Ohio.*

Company's ½ to 2 in. size piloted pressure regulators have sliding gate and plate seats and new external sensing tubes, teflon pilot seat, handwheel, and ball bearing adjustment. For pressures to 250 psi and temperatures to 450 F. Available from stock in bronze, cast iron and ductile iron with screwed ends. For steam, water, air, oil, gas, chemicals. Two bulletins available from manufacturer — "SRB 16-59" and "J-1160".



Power Gas Burner . . .

. . . providing input capacities to 750,000 and 1 million Btu per hr— *Nu-Way Corp., Dept. HPAC,* 2416 *Fourth Ave., Rock Island, Ill.*

New power gas burner models, "G-750" and "G-1000", can be installed in boiler or furnace with horizontal, reversible flue or in any unit originally designed to be fired with power equipment. Available with choice of following: thermoelectric type pilot safety with flash tube ignition of standing type pilot; electronic pilot safety and flash tube ignition of standing type pilot; electronic pilot safety with prepurge and electric, spark-ignited intermittent pilot. New models provide dual control of combustion air for various conditions.

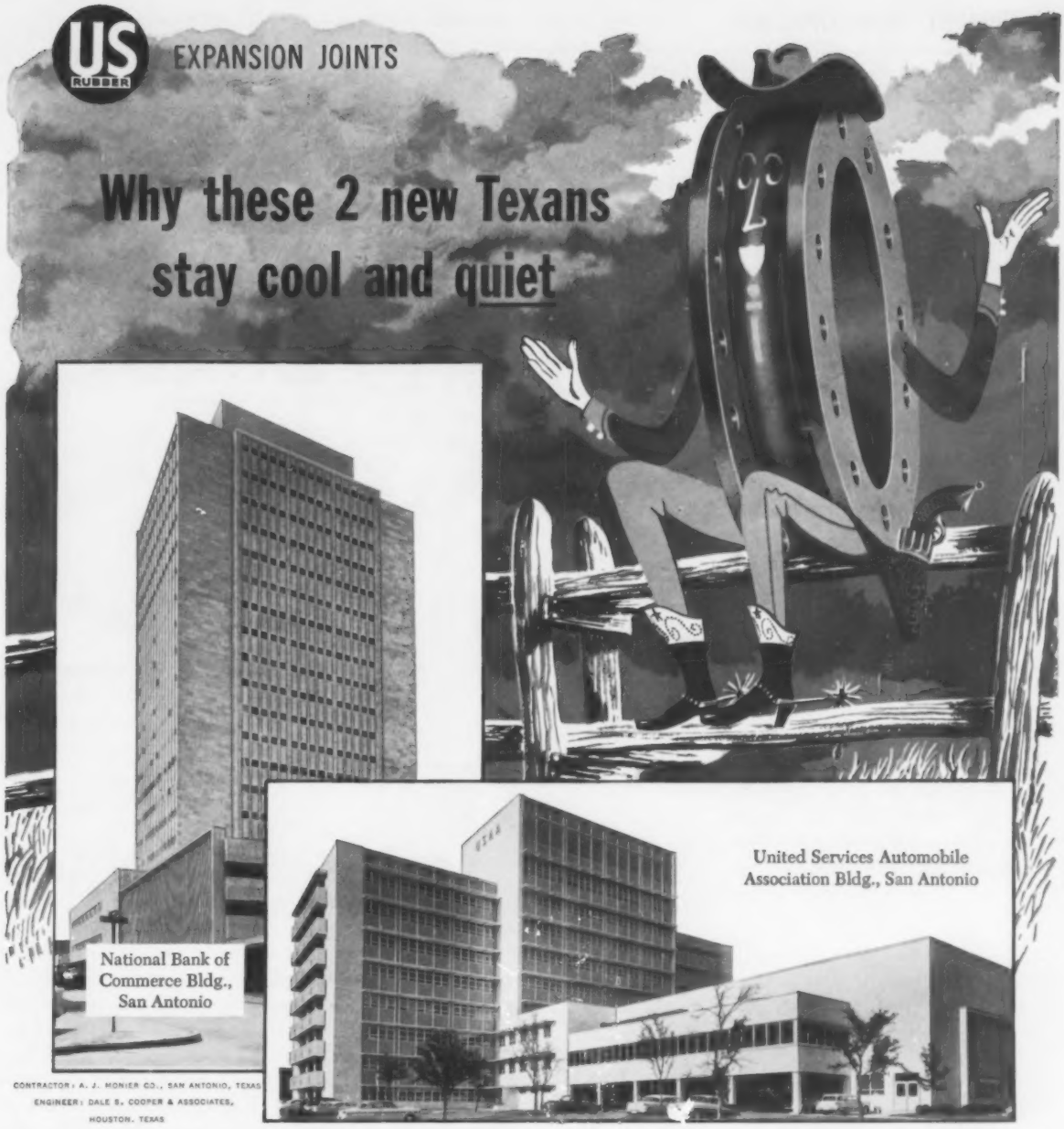
Outdoor Thermostat . . .

. . . available in fixed or in adjustable ratio models—*Automatic Devices Co., Inc., Dept. HPAC,* 714 *Hillgrove Ave., Western Springs, Ill.*

Dialed adjustment of "Weather-Flo" regulators permits raising or lowering the temperature cut-in point. Bulbs available in either rigid, insertion type or in extended tubular form. In basic form, unit effects "on-off" switching action with 10 amp capacity at 115 or 230 volts. Modulating or proportioning models available position valve or damper motor.

US RUBBER EXPANSION JOINTS

Why these 2 new Texans stay cool and quiet



National Bank of Commerce Bldg., San Antonio

United Services Automobile Association Bldg., San Antonio

CONTRACTOR: A. J. MONIER CO., SAN ANTONIO, TEXAS
ENGINEER: DALE S. COOPER & ASSOCIATES, HOUSTON, TEXAS

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The contractor's and the engineer's satisfaction with "U. S." Expansion Joints is based on their past experience with these flexible connections on a variety of jobs.

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EQUIPMENT DEVELOPMENTS
Continued

Pipe Cutting Machine . . .

. . . designed to cut pipe without templates—*Steffan Mfg. Corp., Dept. HPAC, 276 S. Lincoln St., Salem, Ohio.*

"Automatic Contour Cutter" designed to cut pipe at rate of 20 in. per sec. During operation, pipe is clamped into 3 jaw chuck and control settings are made; contour is then cut without templates, layouts, or patterns. Cutting head is supplied equipped with oxyacetylene torch for cutting carbon steel, or "Heliarc" head for cutting aluminum, stainless steel, copper, cast iron, magnesium, or various high alloy steels.

Roof Ventilator . . .

. . . designed for up-blast exhaust ventilation — *Ilg Electric Ventilating Co., Dept. HPAC, 2850 N. Pulaski Rd., Chicago 41.*

New line of 16 "Type UB" propeller roof ventilators features high-speed, high-air capacity for up-blast exhaust ventilation in industrial applications. Capacities range from 3790 to 33,400 cfm. Unit mounts directly over roof opening for exhaust from duct or open area. Has totally enclosed, permanently lubricated, ballbearing motor, butterfly damper and steel propeller of airfoil design, steel housing, steel frame.

Steel Check Valves . . .

. . . designed for high temperature hot water service — *Combination Pump Valve Co., Dept. HPAC, 851 Preston St., Philadelphia 4.*

As forward flow of fluid ceases, stainless steel spring actuated check valve closes automatically. Valves said to work equally well at all fluid temperatures, and are available for pressure ratings from 150 to 2500 psi. Available in two types and in sizes from 2 to 12 in. diam.

Refrigerant Leak Detector

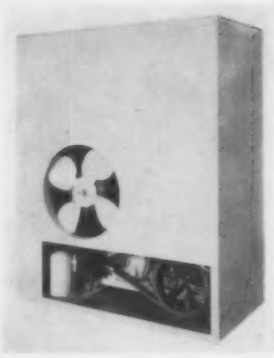
. . . designed to double as blow torch and soldering tool — *Kidde Mfg. Co., Inc., Dept. HPAC, 35 Farrand St., Bloomfield, N. J.*

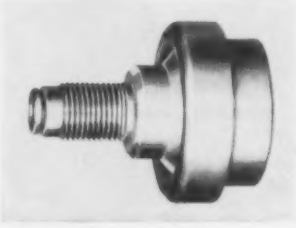
Place leak detector hose at point of suspected refrigerant leakage. Traces of gas turn blue flame bright green. For blow torch use, Halide fitting slips off to provide 3500 F of pin point heat. To solder, slip on small soldering tip.

Air Conditioning Motors . .

. . . for operation on 400 cycle, 3 phase induction principle—*Ellis & Watts Products, Inc., Dept. HPAC, 8407 Monroe Ave., Rossmoyne, Ohio.*

Motors have full-load speeds high enough to be applied without gearing at speeds of 3850, 3320, 2580, 1880 rpm. Life of ¾ to 15 hp motors estimated by manufacturer between 20,000 and 30,000 hr.

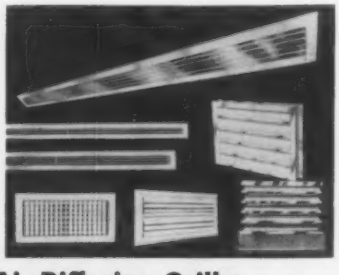




Thermostatic Actuators . . .

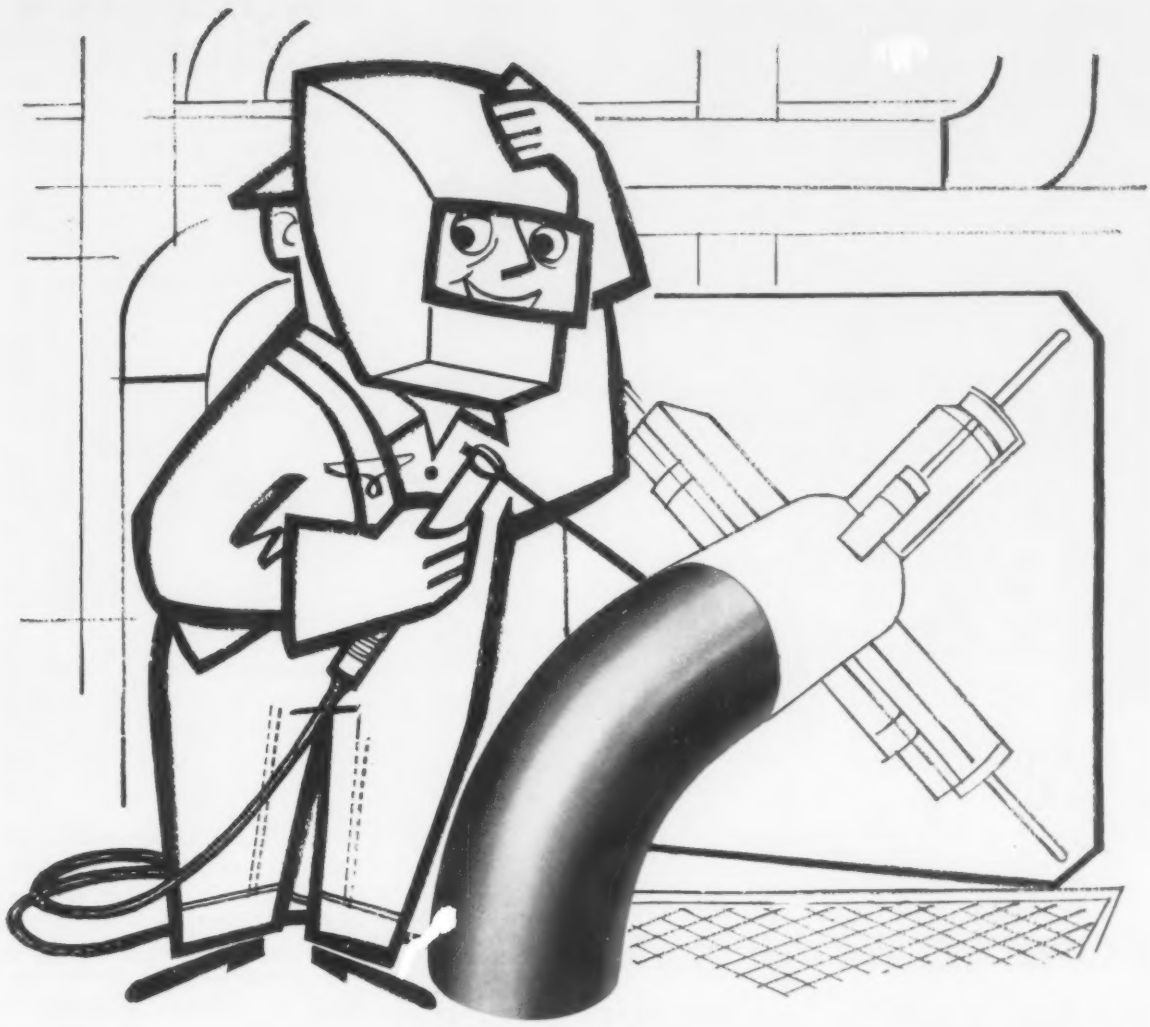
. . . designed to supply mechanical power from small change in temperature — *American-Standard, Detroit Controls Div., Dept. HPAC, 5900 Trumbull Ave., Detroit 8.*

"Vernatherm" actuators use materials that expand as temperature increases to force molded synthetic rubber plug into reduced diameter in piston guide. Movement of piston used to operate valve disc, mechanical linkage, or electric switch. Piston returns when cool, and thermostatic materials reform to original shape. Miniature sizes can lift 30 lb load 1/3 in.; large elements can move 250 lb load ½ in. Temperature control ranges obtained from below zero to 450 F.



Air Diffusing Grilles . . .

. . . available in new line of extruded aluminum construction—*Titus*



B&W JOB-MATCHED WELDING FITTINGS

make piping pre-fabrication more economical

Dimensional accuracy is the key to economical pre-fabrication and installation of process piping . . . and you get true accuracy with B&W Job-Matched Welding Fittings. This means:

- during fabrication sections can be pre-cut and you know they will fit
- welding time is reduced because there are fewer fit-up problems, eliminating time consuming and costly fill-in welding
- fabricated sections can be installed without delays because each fitting is well within tolerance.

Ask for B&W Job-Matched Welding Fittings through local B&W District Sales Office or any qualified welding fittings distributor, or write for B&W Bulletin FB-504, The Babcock & Wilcox Company, Tubular Products Division, Fittings Department, 3839 West Burnham Street, Milwaukee 46, Wisconsin.

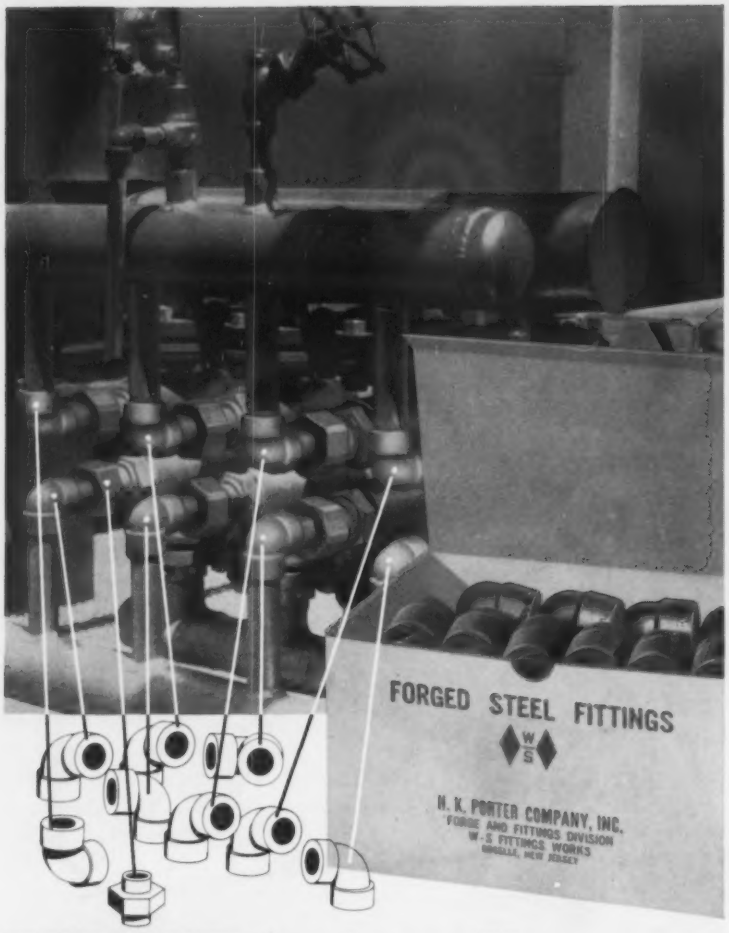
B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION, FITTINGS DEPARTMENT

TA 9023 WF1

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



FORGED for long life
PACKAGED for convenience

The "Forged" in W-S Forged Fittings means dependability under the toughest piping-job conditions. "Forged" gives you the added resistance to pressure, heat, corrosion, shock and vibration needed to make your installations long-lived and safe. And W-S Fittings are easily installed, with tight fits and perfect alignment . . . thanks to W-S precision machining methods and quality forging techniques.

Packaging, too, is a W-S brand advantage. Virtually any "mix" of fitting types and sizes can be packed in a convenient W-S Case or Half-case . . . each type and size in its own carton.

Specify W-S on your next order. For specifications and Distributor locations, write *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, New Jersey.*

FORGE AND PORTER FITTINGS DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

EQUIPMENT DEVELOPMENTS

Continued

Mfg. Corp., Dept. HPAC, Box 810 Hiway 20 West, Waterloo, Iowa.

New "Eagle" line of grilles, registers, linear diffusers, outside louvers, penthouses made of extruded aluminum. Available in over 30 different louver designs, 24 different border designs, and variety of finishes and colors. Can be custom made to fit any design or specification requested.

Inert-Gas Welding Torch . .

. . .developed for manual inert-gas tungsten-arc welding — *Linde Co., Div. of Union Carbide Corp., Dept. HPAC, 30 E. 42nd St., New York* 17.

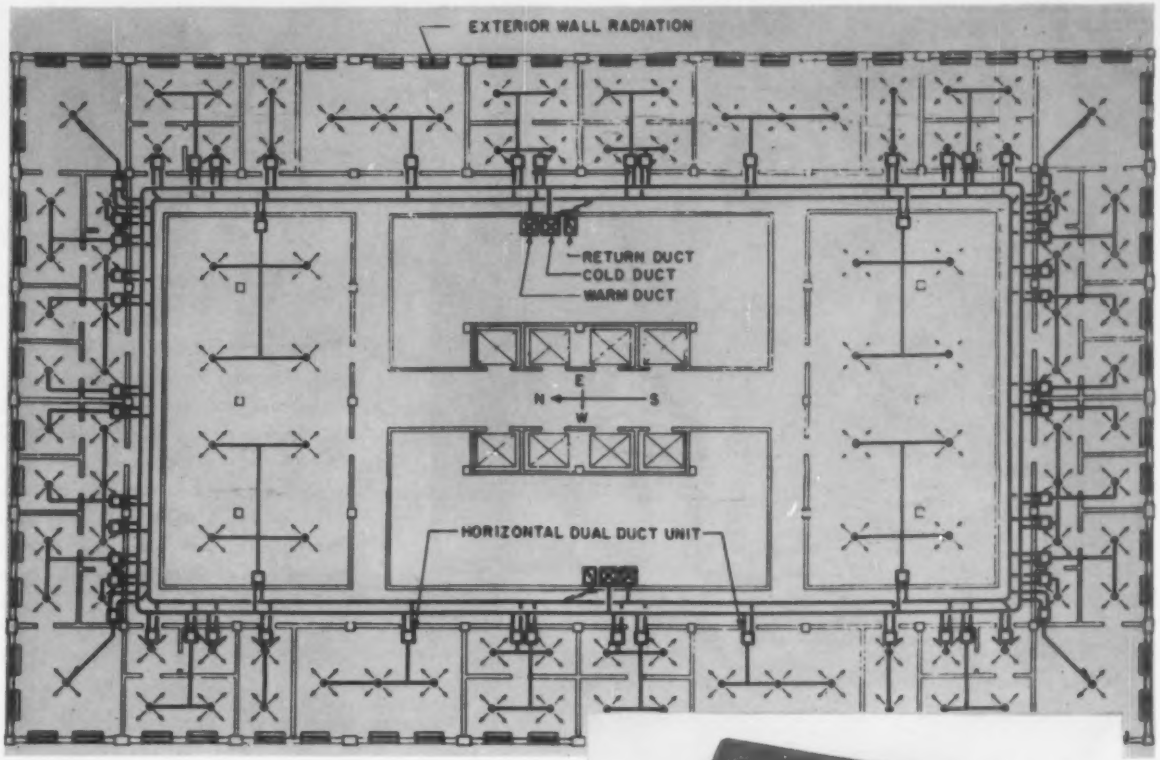
"Heliarc HW-20" designed to operate at currents up to 225 amp on reduced duty cycles, 200 amp on continuous duty cycles. Torch weighs 3.6 lb, is 6⅞ in. long and equipped with flexible service lines. All couplings have standard connections.

Solder Joint Valves . . .

. . .available in 2½ and 3 in. sizes — *Walworth Co., Dept. HPAC, 750 Third Ave., New York* 17.

"No. 4" solder joint valves in-

NO BALANCING BOTTLENECK WITH BUENSOD



Shown above is a typical office building Dual Duct layout with individual overhead mixing units in each zone for selective temperature control. Radiation at the exterior walls prevents undesirable down drafts in cold climates and provides heat during night and weekend operation (existing buildings with radiation systems are usually treated in this manner). Changes in mixing units and zone arrangements may readily be made without disturbing the main system. When equipped with pre-set volume regulators, no balancing of units is required on the job site.

Illustrated: Buensod Type H unit designed for overhead installation, generally above hung ceilings. The unit discharges quietly and may be connected to any standard diffuser or grille. Cutaway shows self-contained volume regulator in place.

Tedious, on-the-job adjustment of volume used to be a major bottleneck in the installation of Dual Duct high velocity air systems. Now Buensod air mixing units with Automatic Volume Regulators eliminate that bottleneck. Units are balanced at the factory to specifications. Upon installation they will deliver the pre-determined air volume ±5%. For renovations of existing buildings, this feature permits zones to become operative upon installation of units. There is no need to wait until the entire job is complete.

A simple, tent-shaped apparatus is the heart of this Buensod unit. It automatically maintains constant air quantity, regardless of static pressure variance on mixing valve inlet or outlet. The volume control is completely independent of any sensing instrument, complicated linkage arrangement or outside power source.

Plan on Buensod for your next project.

BUENSOD DUAL-DUCT

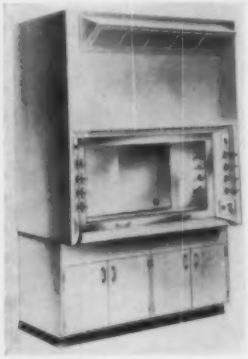
Write for details to: BUENSOD-STACEY INC.—REGRATED

Buensod-Stacey, Inc., 45 West 18 Street, New York 11, New York

EQUIPMENT DEVELOPMENTS

Continued

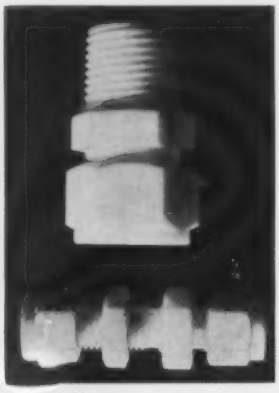
tended for applications involving pressures to 125 psi. Two new sizes in bronze gate valve line added to increase number of applications.



Fume Hoods . . .

. . . designed to use ratio of half room air from building air conditioning system and half auxiliary air — *Kewaunee Mfg. Co., Dept. HPAC,* 5123 *S. Center St., Adrian, Mich.*

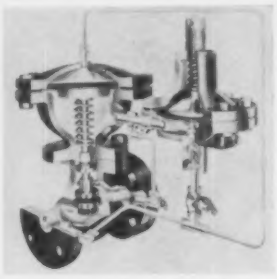
When operating at minimum face velocity of 50 fpm, hoods exhaust 25 cfm of air per sq ft of sash opening from laboratory, with other 25 cfm of air per sq ft of sash opening obtained from auxiliary air source. All air enters through hood face and is said to be effective in sweeping fumes back to baffle exhaust openings.



Tube Fittings . . .

. . . avaiable in teflon—*Crawford Fitting Co., Dept. HPAC,* 884 *E.* 140*th St., Cleveland* 10.

All company's standard "Swagelok" tube fitting shapes and sizes can be secured in teflon. Sizes from 1/16 through 1 in. available.



Pressure Reducing Valve .

. . . designed for control of compressible and incompressible fluids—*C. E. Squires Co., Dept. HPAC,* 18502 *Syracuse Ave., Cleveland* 10.

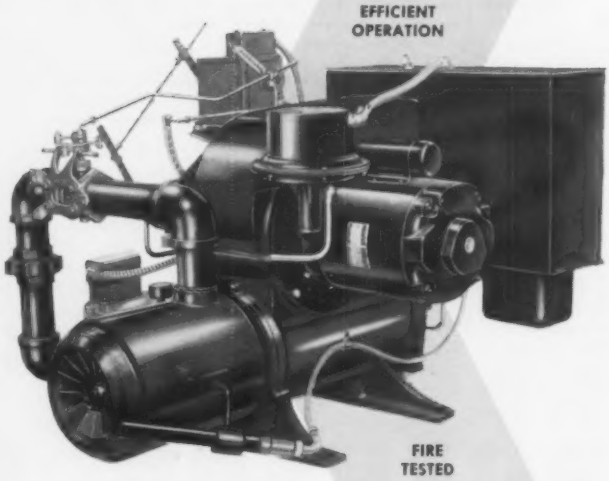
"Class AD" pressure reducing valve provides reduced pressures between zero and 125 psig through use of one of three springs. Unit has teflon guide, self-contained and packless. One step reductions from 600 psig to 1 psig, or intermediate pressures.

Low cost gas burner outstandingly efficient at all flame settings

Precision-engineered commercial-industrial Hev-E-Duty power gas burners are the low-cost answer to high heating efficiency with gas. Automatic electric ignition assures safe starting. Built-in low fire start that builds up slowly to the flame size required means smooth, safe operation. Minimum low fire and maximum high fire can be controlled exactly for top efficiency with any boiler or furnace.

Once set, the burner maintains this setting automatically regardless of weather. Sizes from 720,000 to 21,000,000 BTU. Hev-E-Oil and combination gas/oil models also available. For more information write Industrial Combustion, Inc., 4507 N. Oakland Ave., Milwaukee 11, Wis., Dept. HPA-659.

COMPLETE PACKAGE
SIMPLE INSTALLATION
LOW FIRE START
EFFICIENT OPERATION



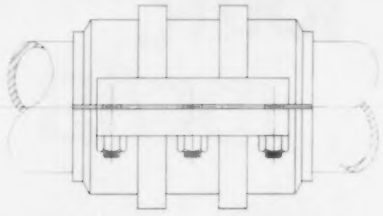
FIRE TESTED
FULLY APPROVED
FACTORY GUARANTEED

INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICE: 4507 N. OAKLAND AVE., MILWAUKEE 11, WISCONSIN

EQUIPMENT DEVELOPMENTS

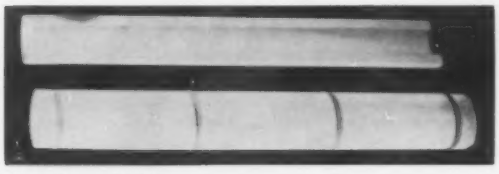
Continued



Split Coupling . . .

. . . designed for pipeline repair applications—*Pipe Line Development Co., Dept. HPAC, 5700 Detroit Ave., Cleveland 2.*

"Smith Split Coupling" is split longitudinally and can be used as coupling, split sleeve, or pipe repair clamp. Clamping means provided to resist endwise pull of pipe when used as coupling. Unit is all steel, can be welded permanently while pipeline is in service to become integral part of pipeline. Available in sizes from 2 to 4 in.



Pipe Insulation . . .

. . . made from pre-molded rigid polyurethane material —*Baldwin-Hill Co., Dept. HPAC, 500 Breunig Ave., Trenton, N. J.*

"Rigid Foam" pipe insulation c[illegible] for low temperature applications down to −3[illegible] F. At mean temperature of zero F, material said to have K-factor of 0.096 Btu per sq ft per hr per deg F. For insulating lines in continuous service between −300 and 250 F. For intermittent steam service, upper temperature limit is 275 F. Can be applied to piping with ⅜ or ½ in. steel bands or with 16 gage tie wires and joints sealed with low temperature mastics. Available in standard IPS sizes from ½ to 12 in. diam. Thicknesses range from ¾ to 2½ in. in ½ in. increments and molded pipe half sections are 3 ft long.

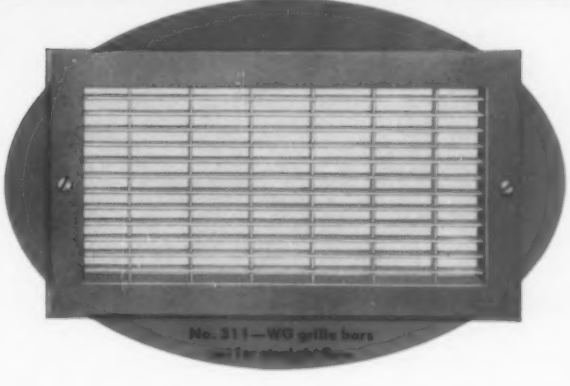
Temperature Monitoring System . . .

. . . said [illegible] be capable of monitoring virtually unlimited number of points continuously—*Fenwal Inc., Dept. HPAC, Pleasant St., Ashland, Mass.*

Continuous monitoring system designed to detect, furnish warning when temperature at any protected point reaches preselected high or low limit. System can be used for monitoring temperatures between −25 and 600 F. For applications such as monitoring bearing temperatures in generators, turbines, pumps, other rotating equipment, as well as temperature protection for processes, processing equipment, pipelines.

SOLID BAR
ALUMINUM WALL GRILLES
Independent "Fabrikated"
REG. U.S. PAT. OFFICE
These wall grilles are famous "Fabrikated" construction but made from solid bar aluminum instead of steel.

No. 311—D-WG grille bars set at approximately 35° down



No. 311—WG grille bars

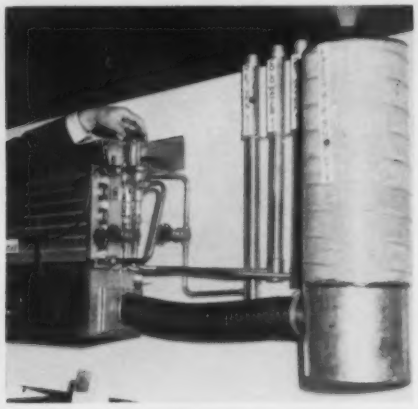
In these grilles, the openings are ⅞" x 1 1/16". Interior grille bars are ½" deep. Outer rims up to vertical 12-inch sizes inclusive are 1 1/16" wide beyond wall openings on all four sides. On sizes over 12-inch vertical, outer rims are 1½" wide on all four sides beyond wall opening size. Approximate depth of all grilles is ¼". Narrower or wider rims available on special order at moderate additional cost.

Always Leading—
Always Progressing

THE INDEPENDENT REGISTER CO.
3747 E. 93rd STREET • CLEVELAND, OHIO

EQUIPMENT DEVELOPMENTS

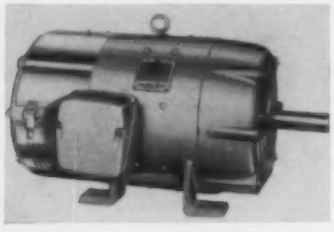
Continued



Air Conditioning System . . .

. . . designed to give room occupant complete control of temperature—*York Div. of Borg-Warner Corp., Dept. HPAC, Roosevelt Ave., York, Pa.*

"Three Pipe Hi-I" air conditioning and heating system derives name from three pipes—hot water, cold water, return—that connect to high pressure induction unit in each room. Thermostat said to provide complete control over system. Especially recommended by manufacturer for hotel applications.



D-C Motors . . .

. . . designed to provide faster response, wider speed range, higher overload capacity—*Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee 1.*

"Flexitorq" motors available in ratings of 1 to 200 hp, in drip-proof and drip-proof guarded enclosures. Features cited include: faster acceleration because of low inertia armature; use of Class B insulation. New line also includes generators in ratings from 3/4 to 170 kw.

Mn Wrought Iron . . .

. . . said to possess strong impact resistance, low temperature properties—*A. M. Byers Co., Dept. HPAC, Clark Bldg., Pittsburgh.*

Alloy designated "Mn" after principal alloying element, manganese. Available in tubular and flat rolled forms for use in petroleum, chemical, refrigeration applications. Product said to possess corrosion resistance, weldability.

(*Continued on page* 172)

YOUR IDEAS WORK BETTER WHEN YOU WORK WITH HONEYWELL

THE FOLLOWING pages bring you some of the latest developments in automatic controls from Honeywell. They widen your choice of products; give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 sales offices throughout the country. Each is staffed with control specialists to assist you in writing specifications and preparing control layouts.

Now a coordinated high velocity double

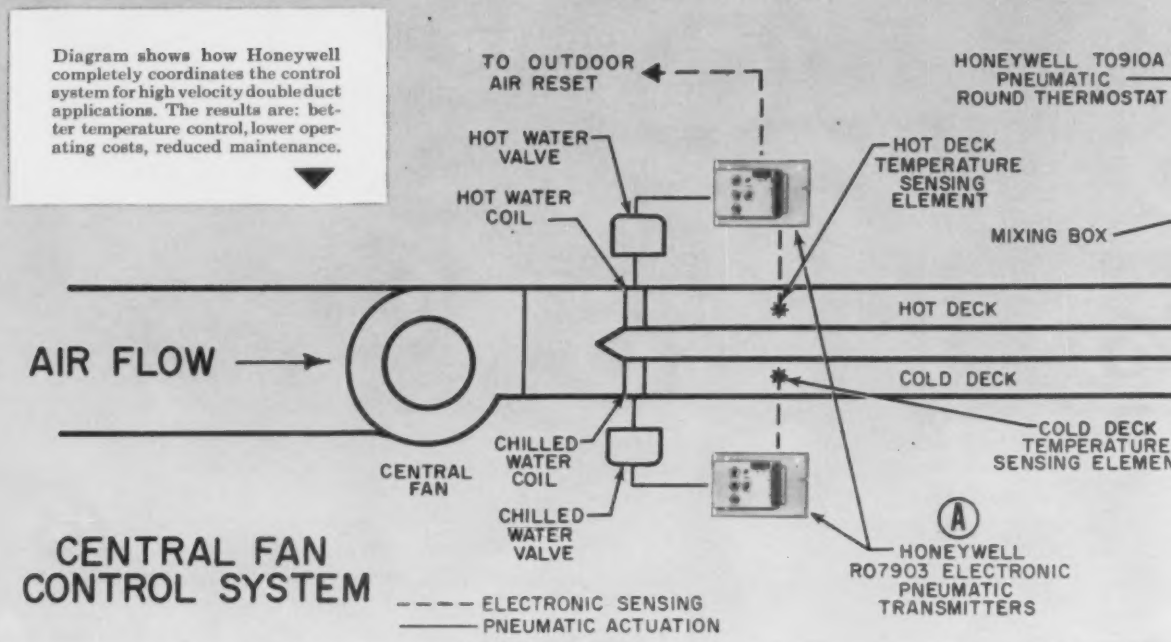
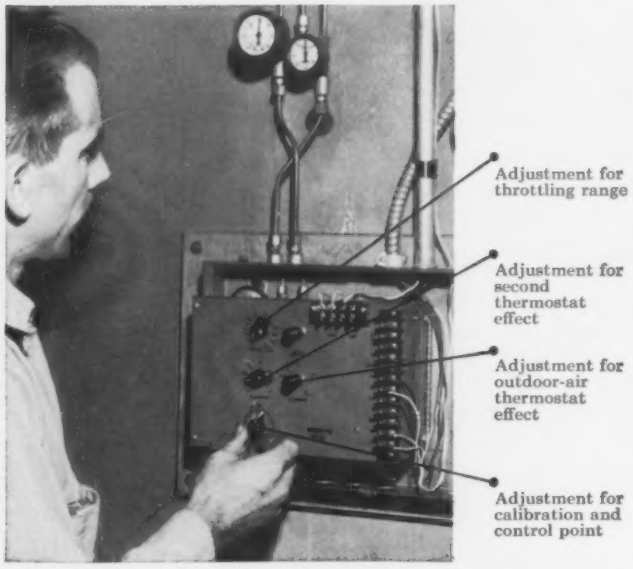


Diagram shows how Honeywell completely coordinates the control system for high velocity double duct applications. The results are: better temperature control, lower operating costs, reduced maintenance.
TO OUTDOOR AIR RESET
HONEYWELL T091OA PNEUMATIC ROUND THERMOSTAT
HOT WATER VALVE
HOT WATER COIL
HOT DECK TEMPERATURE SENSING ELEMENT
MIXING BOX
HOT DECK
AIR FLOW
COLD DECK
COLD DECK TEMPERATURE SENSING ELEMEN
CHILLED WATER COIL
CENTRAL FAN
CHILLED WATER VALVE
A
HONEYWELL RO7903 ELECTRONIC PNEUMATIC TRANSMITTERS
CENTRAL FAN CONTROL SYSTEM
ELECTRONIC SENSING
PNEUMATIC ACTUATION

A

HEART OF THE SYSTEM: New Honeywell RO7903 Transistorized Electronic-Pneumatic transmitter combines the advantages of Electronic Sensing with PNEUMATIC Actuation

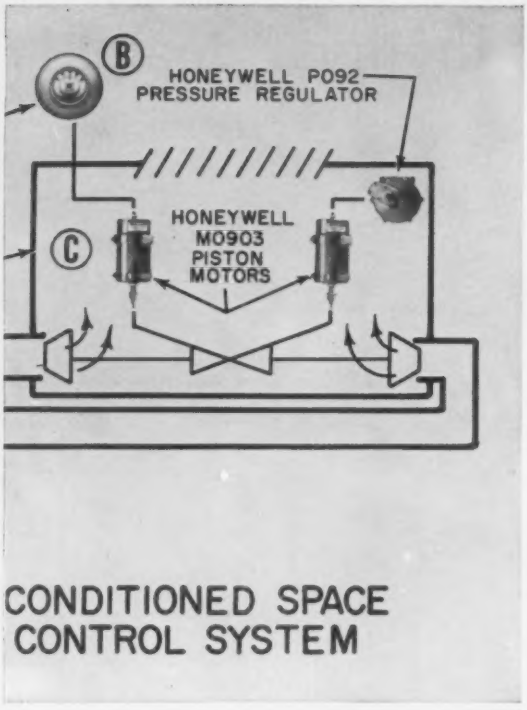

Adjustment for throttling range
Adjustment for second thermostat effect
Adjustment for outdoor-air thermostat effect
Adjustment for calibration and control point

Now all setting adjustments for a master-submaster system can be made at one central location—scientifically and precisely. Difficult, inexact on-the-spot adjustments at sensor locations, thermostats and elements can be eliminated. There's a free choice of sensor locations because they no longer need be accessible for system adjustment.

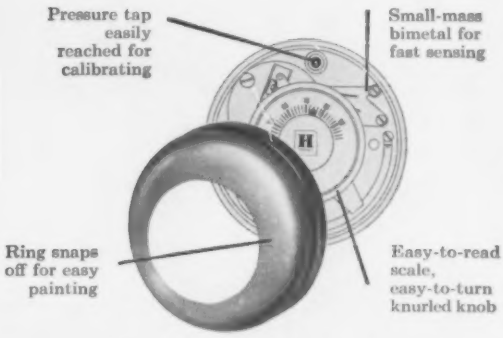
This new relay combines the sensitivity, freedom from ambient temperature effect, fast response and versatility of *electronic sensing*, with the powerful, rugged economy of *pneumatic actuation*. It provides an easier way to do a better job.

Honeywell's new electronic-pneumatic transmitter comes with a choice of specialized sensing elements, costs little more than old-fashioned master-submaster control systems, saves on installation and operating costs. For more information about its many applications, call your nearest Honeywell office.

ble duct pneumatic control system!



B The Honeywell Pneumatic Round for ideal room temperature control


Pressure tap easily reached for calibrating
Small-mass bimetal for fast sensing
Ring snaps off for easy painting
Easy-to-read scale, easy-to-turn knurled knob

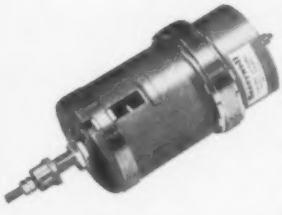
To assure close temperature control in the conditioned space, specify the famous Honeywell Pneumatic Round Thermostat. The fastest responding pneumatic thermostat on the market, it is also the most accurate. Simplified design and a complete line of fittings make it easy to install and maintain. New rugged stainless steel tamper-proof cover is available.

C For economical mixing box control choose the Honeywell Volumatic* system

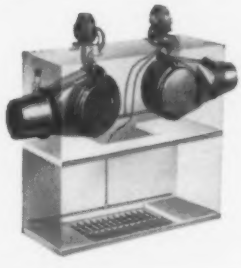
Honeywell's Volumatic* system provides dependable, economical volume control of double-duct systems. It uses the new M0903 piston motor with nylon bearings which require less lubrication. And its sensitive P092 Pressure Regulator provides accurate control of volume.

The new Honeywell Volumatic system is adaptable to mixing boxes of any size, made by any manufacturer, and can be used with many types of linkages.

Volumatic's P092 Pressure Regulator: large diaphragm area provides maximum sensitivity and speed of response; metal to metal flapper and nozzle give long, service-free life; snap-on rubber hosing and fixed restriction make installation easy.



Volumatic's M0903 Piston Motor regulates air mixture valves smoothly and accurately, gives smooth modulation. All exposed parts are treated for moisture resistance. Large diameter nylon bearing provides better service with less lubrication.



For the finest mixing box performance choose the Honeywell Duablend* system

Honeywell's Duablend* system gives the finest mixing box performance available anywhere. Superb performance is secured by using *two* pressure regulators to assure constant volume from each duct (under control of space thermostat) regardless of pressure changes. Exclusive Sub-master pressure regulator provides a similar stabilizing control action to the Sub-master duct thermostat in heating and ventilating units.

*Trademark

Honeywell's new Selectographic DataCenter* features modular design!

It simplifies application, adds new economy to centralized control!

THE HONEYWELL DataCenter lets one man do the work of a crew—set temperatures, make adjustments, supervise critical areas of an entire building's air conditioning system from one central location.

And Honeywell's modular building block design gives greater economy, new flexibility. Starting with the basic unit—the central Selectographic Console—modules of a standard 2′ by 2′ dimension may be added as the need arises or as budget permits. Honeywell's Selectographic DataCenter can be installed in buildings of all sizes, for all purposes; can grow with your needs.

For more information about this panel, call your local Honeywell office. Or write Honeywell, Dept. AC-6-92, Minneapolis 8, Minnesota.

*Trademark

FOR MORE TO WORK WITH WORK WITH HONEYWELL

Honeywell

H HONEYWELL First in Control

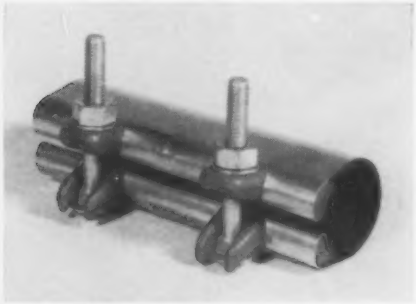
EQUIPMENT DEVELOPMENTS

Continued from page 168

Air Conditioning Unit . . .

. . .available in recent modification of company's standard line—*Governair Corp., Dept. HPAC,* 4840 *N. Sewell, Oklahoma City, Okla.*

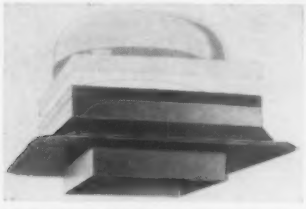
"SCU-MH" model air conditioning unit has 10 and 15 ton hermetic compressors in multiples required to furnish capacities from 10 to 75 tons. Capacity reduction accomplished by multiple circuits and/or by use of back pressure regulating valves.



Pipe Repair Clamp . . .

. . .developed for quick repair of leaks or breaks in steel piping—*Dresser Mfg. Div., Dresser Industries, Inc., Dept. HPAC,* 49 *Fisher Ave., Bradford, Pa.*

"Style 118 Handiband" repair clamp snaps around pipe; bolt head is dropped through open-slotted lug and nut is tightened. Compression of large size gasket seals leak. Available for pipe sizes ½ through 8 in. in 3, 6, 9, 12 in. lengths.



Roof Ventilator Curb Base . . .

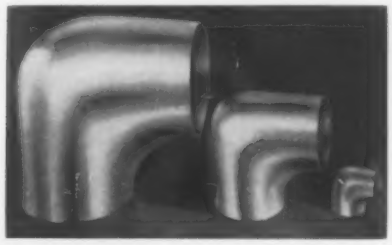
. . .available with automatic or motor-operated louvers —*Loren Cook Co., Dept. HPAC,* 227 *Depot St., Berea, Ohio.*

Curb base fits into framed opening, is fastened by nailing, bolting, or welding to deck. Ventilator fits over curb and fastens to wood top frame. Extended collar at bottom of curb houses louvers. "VC" curb made of heavy gage steel with insulated double walls. Available in 12 sizes for use with ventilators ranging from 16 to 48 in.

Downflow Heater . . .

. . .designed for applications with high ceilings or obstructions—*Reznor Mfg. Co., Dept. HPAC,* 51 *Union St., Mercer* 8, *Pa.*

Heaters can be installed 40 ft above floor level to heat airplane hangars, fieldhouses, warehouses, manufacturing plants, etc. Direct-fired unit available in four basic sizes from 300,000 to 600,000 Btu per hr. Units can be installed in multiples for higher capacities. Heater consists of duct furnaces with automatic controls, large propeller-type fan. Aluminized steel heat exchangers and on-off gas valves with 115 or 230 volt controls included. Bulletin describing heater available upon request from manufacturer.

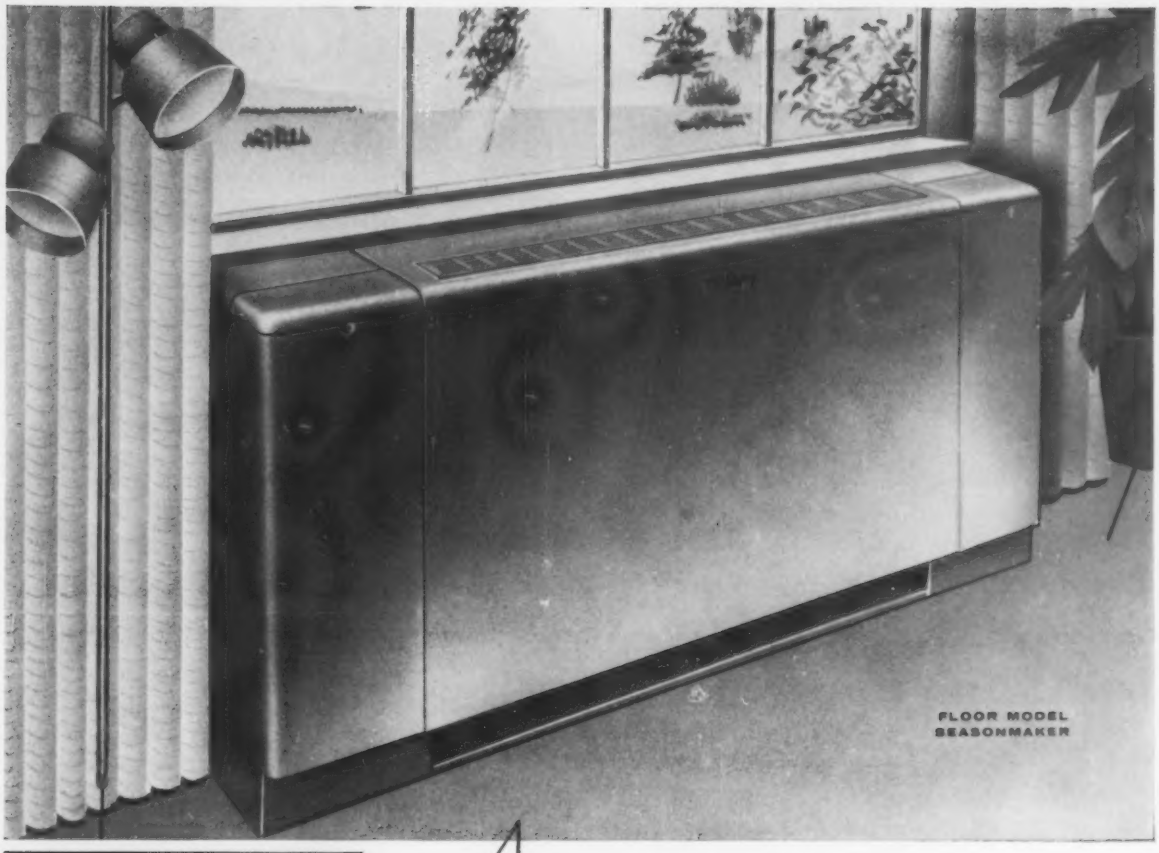


Aluminum Elbows . . .

. . .designed to automatically compensate for pipe expansion and contraction and for differences in radii that vary with pipe sizes, insulation thickness—*General Aluminum Supply Corp., Dept. HPAC,* 1506 *Eastern Ave., Kansas City* 26, *Mo.*

"Gasco" humped aluminum elbows available in 13 sizes to fit 109 combinations of varying pipe sizes and insulation thicknesses ranging from 3 in. OD through 12.81 in. OD. Elbow halves can be clamped with two metal bands, with no cutting away of insulation material to fit elbow. Elbows are two piece, heavy gage (0.025 to 0.032 in.). Inside, outside surfaces are smooth and designed to fit either long or short radius ells.

(*Continued on page 177*)



5 SIZES EACH
only 8½" thin

4 new thin-line design INDIVIDUAL ROOM SEASONMAKERS...

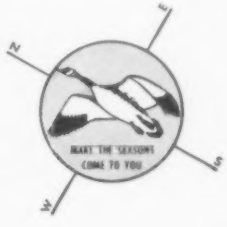
These McQuay thin-line design Seasonmaker individual room air conditioning units are only 8½ inches thin and 25 inches high or deep, and offer you more compact, modern styling, requiring a minimum of installation space.

There are four models—each in five sizes, 220, 330, 440, 520 and 640 cfm. The four smaller sizes are equipped with 1050 rpm motors, while the largest has 1500 rpm. Hand-of-coil connections are easily reversed in the field. Filters are changeable without removing decorative panels.

All McQuay Seasonmakers are ultra-quiet in operation and furnish individual room comfort at any desired temperature level. They are quick and easy to install and service, and ideal for multi-room buildings such as hotels, motels, schools, hospitals, offices and residences. Call the McQuay representative in or near your city for complete information about these new thin-line design Seasonmakers, or write McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION



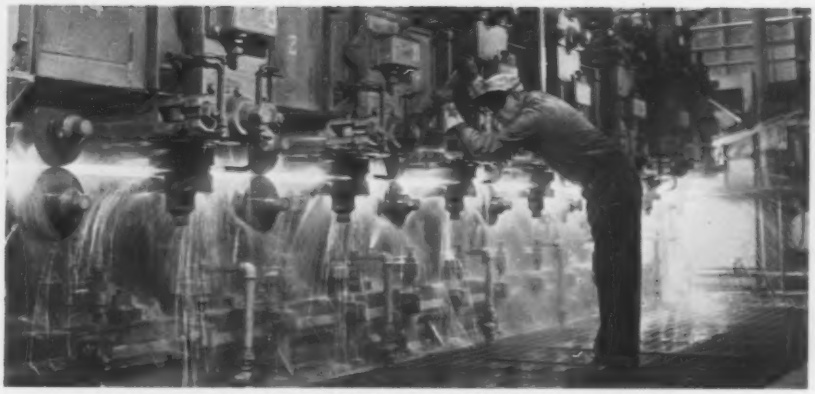
THE NEW CHRYSLER STAMPING PLANT

In the boiler house of this stamping plant operation at Twinsburg, Ohio, there are more than 1800 tons of J&L Jal-Con-Weld pipe carrying steam, water and air through the 34-acre plant.

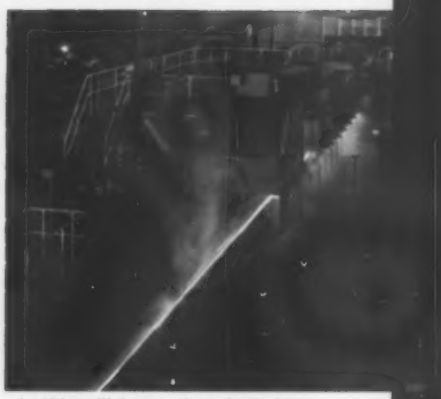
These coal-fired boilers supply 150,000 pounds of steam per hour under 150 psi through Jal-Con-Weld pipe.

Four air compressors deliver up to 30 million cubic feet of air per day at a pressure of 100 psi through Jal-Con-Weld pipe to air tools on the 28 major press lines, plus tool room and assembly areas.

Three 2500-gallon-per-minute pumps keep cooling water circulating through Jal-Con-Weld pipe to scores of spot welding units in the assembly lines.



A continuous strip of skelp, heated to a welding temperature of approximately 2450°, passes rapidly through the forming rolls where it is shaped into cylindrical form.



In this mill, inspections include hydrostatic testing on each line in two modern Schloemann testers.

Finishing operations include cutting to proper length, straightening, facing, threading and hot dip galvanizing.

"Jal-Con-Weld pipe guarantees trouble-free installation and performance"

. . . says president of The Stanley-Carter Company

Over 1800 tons of Jal-Con-Weld pipe were installed by The Stanley-Carter Company in this new Chrysler stamping plant in Twinsburg, Ohio.

"J&L pipe is uniformly round, straight and easy to work," said Mr. Stanley Carter. "And, we like the service available through J&L and its distributors."

The distributor who handled this job was H. J. Rothwell Fitting Company, Canal Fulton, Ohio.

Jal-Con-Weld pipe is produced on two of the most modern continuous weld pipe mills in the world. These mills were installed by J&L at a cost of $18,000,000, and incorporate the most advanced equipment to produce high quality standard pipe in sizes which range from one-half inch to four inches.

The continuous weld process utilizes skelp in coil form. Weld is formed by pressure rolls, under ideal temperature conditions. Before skelp enters the welding pass, a jet of air is blown on the edge to remove scale and increase temperature for a stronger weld.

It will pay you to standardize on controlled-quality Jal-Con-Weld pipe.

Call your nearby J&L distributor, or for more information, write for J&L's new bulletin, "Jal-Con-Weld," Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

Jones & Laughlin Steel Corporation

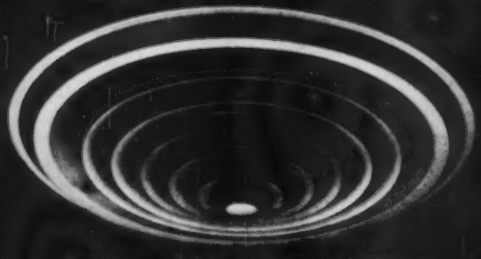
PITTSBURGH, PENNSYLVANIA

A Standard of Comparison of Airconditioning Registers and Grilles—The World Over

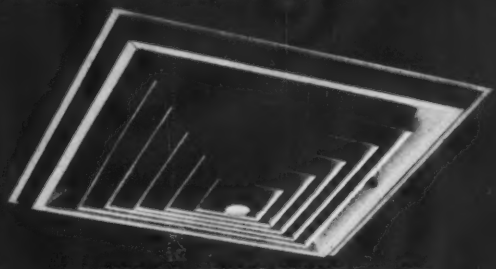
The HIGHEST QUALITY — The MOST COMPLETE LINES — From The Industry's FINEST Facility.

The No. 1500 ROUND CEILING DIFFUSER — The No. 2500 SQUARE CEILING Diffuser

REALLY "The BEST For LESS"—DESIGNED To COMPARE with Higher Priced LINES.



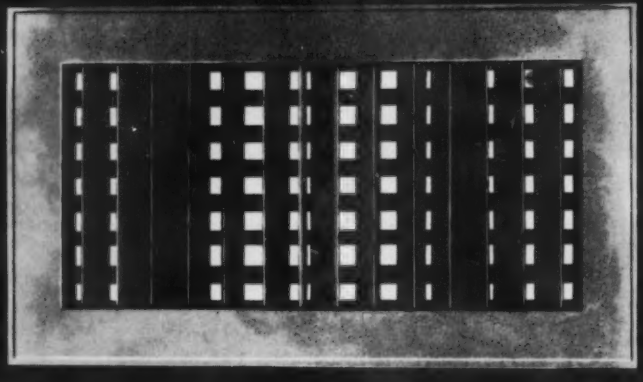
No. 1500 U.S. ROUND CEILING DIFFUSER



No. 2500 U.S. SQUARE CEILING DIFFUSER

Both No. 1500 Round and No. 2500 U.S. Square CEILING DIFFUSERS May be Equipped with the Smoothest and Most PERFECT Knob-Operated Bi-Valve Damper—An Original U.S. FEATURE.

The WORLD-APPROVED LINE of SILENT PERFORMANCE, GREATEST AIR-HANDLING POWER, and PERFECT AIR DISTRIBUTION For WARMING and COOLING AIR CONDITIONING

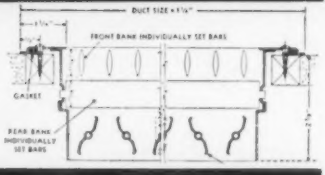


No. 190 U.S. MULTI-FLEX REGISTERS

DOUBLE BANKS of Double-Edged STREAM-LINED BARS give any Direction of UP-FLOW, DOWN-FLOW or LATERAL FLOW DESIRED. Use 190 MULTI-FLEX REGISTERS ANYWHERE in COMMERCIAL or RESIDENTIAL Applications — for PERFECT AIR HANDLING and Volume Control — for Complete Satisfaction and Efficiency and ORIGINAL COST ECONOMY.

SCREWDRIVER OPERATED OPPOSED VALVES — ORIGINAL No. 190 Equipment

OPPOSED REAR VALVES—AN ORIGINAL PATENTED U. S. FEATURE—gives ACCURATE, INSTANT AIR VOLUME CONTROL. Special Valve Design plus STREAMLINED GRILLE BARS give WHISPER QUIET AIR FLOW at ALL PRACTICAL VELOCITIES. Screwdriver setting means no LOOSE KEYS to LOSE.



UNITED STATES REGISTER COMPANY

BATTLE CREEK, MICHIGAN

MINNEAPOLIS • KANSAS CITY • ALBANY

EQUIPMENT DEVELOPMENTS

Continued from page 172

Relief Valves . . .

. . . for applications with water heaters—*A. W. Cash Valve Mfg. Corp., Dept. HPAC, Wabash and Morgan Sts., Decatur, Ill.*

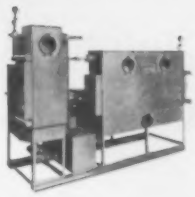
"Type NV Series" temperature-pressure relief valves have patented thermostatic element, with no fluids to leak out. Valves automatically close after relieving. Available in heavy cast bronze bodies, with or without test levers and 6 in. stems and in ½ or ¾ in. male inlet connections. Provided with relief settings from 50 to 200 psi.

Water Heater . . .

. . . for apartment and office buildings, industrial plants, schools, etc.—*A. O. Smith Corp., Permaglas Div.,*

KATHABAR® SYSTEMS

Give these advantages to specifying engineers:



STERILE AIR

Now you can design spaces to maintain air sterility as scientifically as temperature and humidity. Only Kathabar enables you to deliver air at 5 micro-organisms per 10 cu. ft. or less, continuously.

PRECISE DESIGN

Reduce dew point of air from 72 F to 46 F with 85 F water! No over-cool & re-heat costs. Kathabar lets refrigeration handle sensible cooling only (sensible, economical). Deliver consistent gr./lb. and DB for process, storage, testing in foods . . . concrete . . . chemicals . . . paper . . . printing . . . rocket fuels . . . "clean" rooms . . . everywhere.

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SURFACE COMBUSTION CORPORATION

2384 Dorr Street, Toledo 1, Ohio

Send facts on Kathabar systems for following application:

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name & title.....

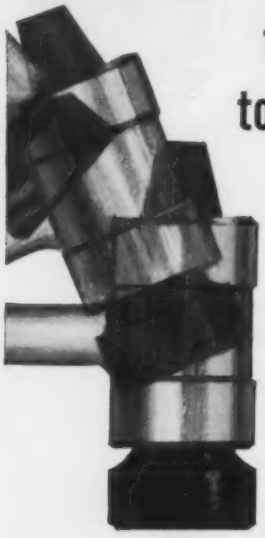
company.....

street.....

city.....*zone*.....*state*.....

59-3E

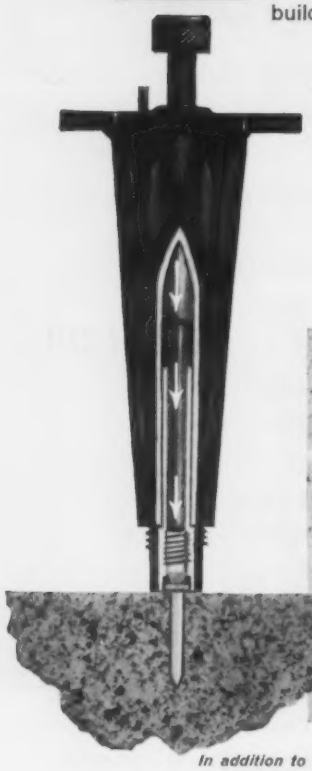
COUNT ON SHURE-SET



the "power-concentration" tool that revolutionizes light fastening!

With Shure-Set's unique "Power Transfer" design, you can drive pins and threaded studs right through light-gauge metal into concrete with a few strokes of a hammer. The hammer-driven Shure-Set light fastening system is ideal for carpenters, plumbers, electricians, builders, and maintenance personnel for quick, reliable fastening into steel, concrete, or building block... no drilling or cartridge required.

Shure-Set supports the fastener until it is driven home . . . no duds, no bent studs or pins, no smashed thumbs. Try Shure-Set and you'll save time, money, and temper while doing a better job. Look for your Shure-Set dealer under "tools" in the yellow pages.



In addition to hammer-in Shure-Set, the versatile Ramset Fastening System includes Ramset powder-actuated method for heavier fastening, and Ringblaster® heavy-duty kiln gun.

OLIN MATHIESON CHEMICAL CORPORATION — Shure-Set®

Ramset Fastening System

WINCHESTER-WESTERN DIVISION • OLIN MATHIESON CHEMICAL CORPORATION
12109-F BEREA ROAD • CLEVELAND 11, OHIO

EQUIPMENT DEVELOPMENTS
Continued

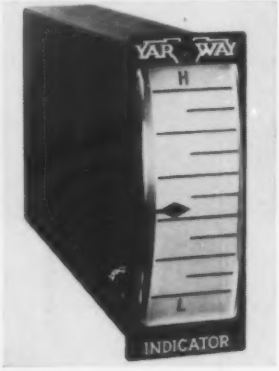
Dept. HPAC, Kankakee, Ill.

New "Burkay 668" water heater has input of 300,000 Btu per hr, and is approved for 180 F temperature service. Unit provides recovery rate of 288 gph at 100 F rise. Features cited: rust free construction with all parts in contact with water made of copper, brass or bronze; finned heat exchanger; available for use with natural, mixed, manufactured, or liquefied petroleum gas.

Circulator Valve . . .

. . .for use with copper tubing — *Hammond Valve Corp., Dept. HPAC, 1844 Summer St., Hammond, Ind.*

Straightway circulator valve "No. 208" developed for use without unions. Available in 3/8, 1/2, 3/4, 1 in. sizes. Recommended for use with concealed convector type radiators and in certain types of baseboard radiation. Balancing fitting "No. 308" without unions also available in 1 in. size.



Liquid Level Indicator . . .

. . .of secondary type designed to duplicate readings from primary liquid level indicator or pressure trans-

ROBVON

BACKING RINGS

APPROVED FOR WELDED PIPE, VALVES, AND FITTING JOINTS

- ✓ Nub diameter automatically sets welding for root pass
- ✓ Forms perfect welded joint eliminating slag and icicles
- ✓ Allows complete penetration and fusion
- ✓ Eliminates the necessity of tack welding
- ✓ Radiographs a perfect certified weld

Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel, Aluminum and Copper

TYPE CCC Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB conforms to the diameter of weld rod. Robvon rings are beveled to assure non-restricted fluid flow.

TYPE CC Designed to allow quick easy alignment of pipe where the inside diameters are slightly out of round. The welder has the choice of "STRIKING OFF" the NUBS or leaving them intact to be melted into the weld mass of the first root pass.

TYPE C Designed for precise tolerance fit-up. Type "C" NUBS conform to the diameter of the weld root. The NUBS melt with the metal to give complete penetration and fusion.

WRITE FOR FULL INFORMATION

ROBVON ALSO MANUFACTURES MACHINED RINGS TO CUSTOMER'S SPECIFICATIONS. ALL FABRICATED SOLID MACHINED RINGS X-RAYED.

ROBVON
BACKING RING COMPANY

675 Garden Street **Elizabeth, N. J.**

Unit-Mounted "Packaged" Controls Improve Unit Ventilator Performance

Barber-Colman controls available for all types of unit ventilators . . . design permits economy of factory installation, allows accurate estimates

Unit-mounted "packaged" control systems for unit ventilators offer important cost and performance advantages:

1. The complete control system, including the room thermostat, is unit mounted. The wall thermostat is eliminated. Installation cost is lower and factory installation is practical.
2. Cost estimating is simplified and becomes more accurate as package controls eliminate many installation variables.
3. Control accuracy is improved because a true aspirating principle is employed and thermostat cannot be tampered with by unauthorized personnel.

Barber-Colman "packaged" control systems, containing all necessary components, interconnecting plug-in wiring and damper linkage, are available for the four basic types of unit ventilators in common use today. The various systems are described in the following paragraphs.

Steam and hot water units utilizing coil valves for control of heat output: Refer to Fig. 1. In this system a unit-mounted room and discharge thermostat controls a motor-operated valve located in the coil supply or return line. This valve, with high rangeability equal percentage throttling plug, adjusts heat output by controlling rate of steam or water flow through the coil, thus providing sensitive and uniform (free from cycling) temperature control. The discharge element insures positive control of discharge temperatures throughout the entire heating and cooling cycle.

A spring-return motor operator, combined with a unit-mounted thermostat, controls damper position. Positive sequencing prevents outside air damper from opening beyond minimum before the coil valve is tightly seated. This assures most economical operation and proper control of discharge temperatures during periods of ventilation and natural cooling.

Hot water units utilizing face and bypass damper control of heating (or cooling) output: Refer to Fig. 2. Controls for these units include a combined unit-mounted room and discharge thermostat and positive positioning motor operator, which act together to position the coil bypass and the outdoor-return air dampers in positive sequence, affording balanced control of both room and discharge temperatures. In units equipped for chilled water cooling, a change-over thermostat senses change in supply water temperature and switches the unit ventilator control system to the appropriate cycle.

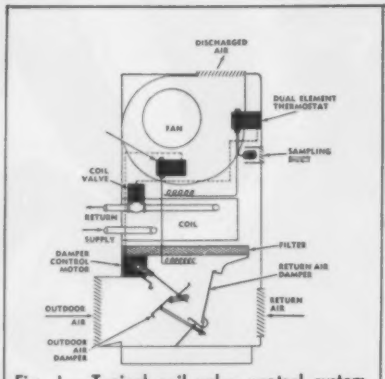


Fig. 1 — Typical coil valve control system.

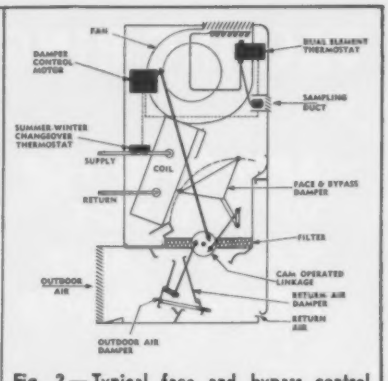


Fig. 2 — Typical face and bypass control system. Shown with change-over thermostat.

Electric heat units: Refer to Fig. 3. A single controller (combined dual-element thermostat, positive-positioning motor operator and heater control switches, all on one chassis) accomplishes smooth system response by positioning the outdoor-return air damper, energizing or de-energizing heaters in increments and opening or closing the fan motor circuit. De-energizing of unit fan motor and heaters during unoccupied periods or on shutdown is automatic.

Gas and oil-fired units: Refer to Fig. 4. A dual-element thermostat and positive-positioning motor operator (advantageously combined in some units) positions the outdoor and return air dampers, and provides time-modulated on-off control of the heat source.

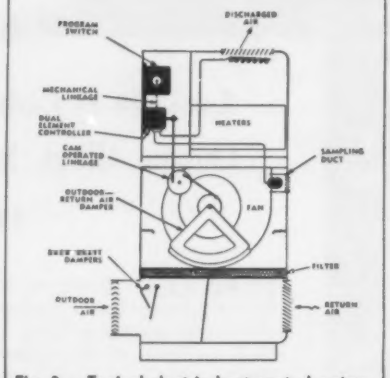


Fig. 3 — Typical electric heat control system.

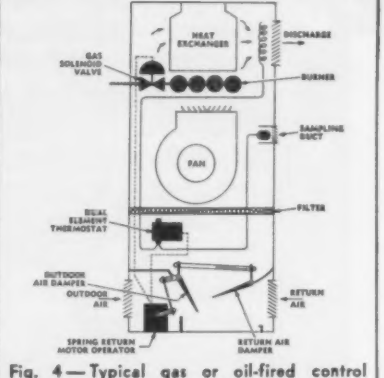


Fig. 4 — Typical gas or oil-fired control system. Shown equipped for gas operation.

Note: Information on control systems for all large-capacity auditorium-type units is available on request.

Ask for New Application File — Specifications and details on control hook-ups for all leading makes and models of unit ventilators. Call your Barber-Colman representative or write today.

BARBER COLMAN **Automatic Controls**

"Better Control . . .Electrically"

BARBER-COLMAN COMPANY

Dept. R, 1301 Rock Street, Rockford, Illinois
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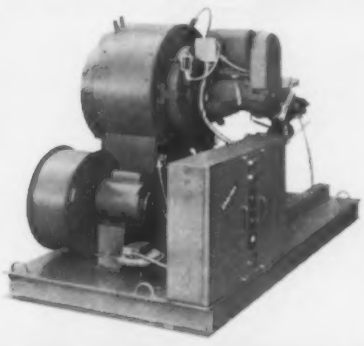
Webster

GAS and/or OIL BURNERS



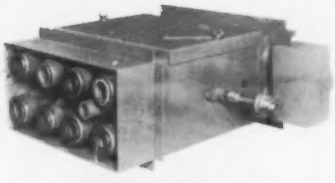
LARGE or SMALL

SINGLE or DUAL FUEL

PACKAGED or FIELD ASSEMBLED

ATMOSPHERIC or FORCED DRAFT

ELECTRONICS of ALL TYPES



COMPETENT
Sales and Service
in all areas

Write for Bulletin B1

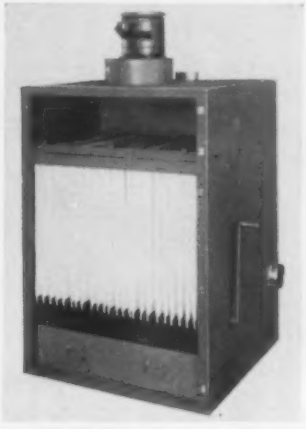
The
WEBSTER ENGINEERING
Company
Box 5246, Tulsa, Oklahoma

EQUIPMENT DEVELOPMENTS

Continued

mitter at any point in plant — *Yarnall-Waring Co., Dept. HPAC, 107 Mermaid Ave., Philadelphia* 18.

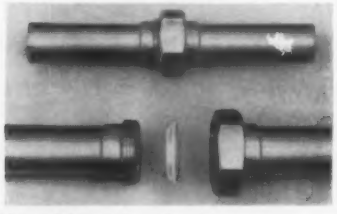
Miniature secondary liquid level indicator is ¼ size of company's standard indicator. Transistorized amplifier is used in place of vacuum tube design in full-sized model. Weight of unit is approximately 5 lb; face dimensions are 2½ in. wide × 6¼ in. high.



Dust Collector . . .

. . . developed to operate in 650 to 1535 cfm range—*Torit Mfg. Co., Dept. HPAC, Walnut and Exchange Sts., St. Paul, Minn.*

"Model 90" cabinet cloth filter type dust collector said to have overall collection efficiency of over 99.9 percent by weight, even with high concentration of particles smaller than 1 micron. Equipped with hopper base, dust capacity is 9 cu ft. Collector driven by 3 hp, 3450 rpm, 220/40 volt, 60 cycle, 3 phase vertical motor. Total cloth filtering area is 250 sq ft. Unit stands 76 in. high.



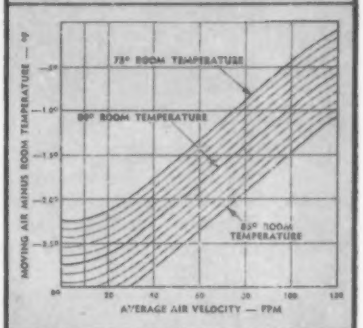
Pipe Line Gaskets . . .

. . . in full range of sizes — *Amasco Products Div., American Machine and Solvents Co., Dept. HPAC, 79-*

✻ Comfort Chart
Conditions Guaranteed

. . . with Barber-Colman Automatic Controls and Air Distribution components working together in a "combination system"

✻ COMFORT CHART


MOVING AIR MINUS ROOM TEMPERATURE — °F
75° ROOM TEMPERATURE
80° ROOM TEMPERATURE
85° ROOM TEMPERATURE
AVERAGE AIR VELOCITY — FPM

COMFORT STANDARDS

Barber-Colman engineers, through exhaustive tests, have determined a Human Comfort Standard for air conditioning. This research has resulted in the development of the chart shown above, which serves as a criterion for rating performance of air conditioning systems as related to human comfort. The chart indicates conditions of air movement and temperature in an occupancy zone. The line shown for each average room temperature is the limit of satisfactory comfort conditions. All points below the line represent uncomfortable conditions while those above the line fulfill human comfort standards.

Working Together

With a Barber-Colman "combination system," comfort chart conditions are guaranteed because: *correct correlation between air movement and room temperature is established* through accurate, dependable *Electronic* temperature control and *Uni-Flo* engineered air distribution — and because *Barber-Colman assumes the undivided responsibility* for complete system performance.

Call your nearby Barber-Colman Automatic Control and Air Distribution office for descriptive literature, or write us:

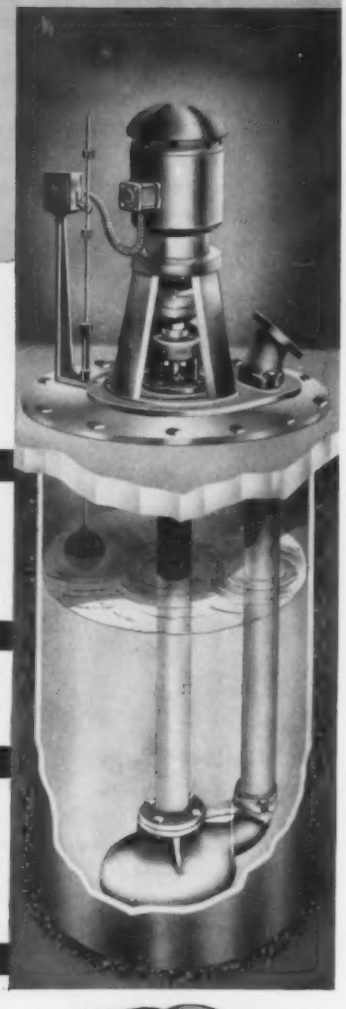
BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. R, 1601 Rock Street, Rockford, Illinois

SCREENLESS PUMPS for

SEWAGE PUMPING
DRAINAGE PUMPING
with a REAL NON-CLOG IMPELLER



This HEAVY DUTY Sewage and Sump Pump with the famous NON-CLOG Impeller, effectively handles large diameter solids, rags and stringy material which are washed into the sewage pit.

RUGGEDLY BUILT

This factory assembled unit has an ample reserve of strength to meet the most severe conditions and to furnish years of trouble-free operation.

SIMPLIFIED INSTALLATION

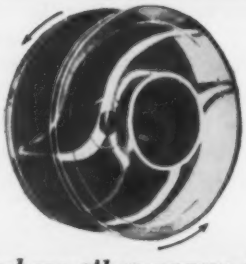
Only one piping connection required. Only one electrical connection. An ECONOMICAL installation.

CAPACITIES

A large selection of units to meet every need. Capacities to 1500 GPM; heads to 86 feet; can be supplied with 1750 RPM, 1140 RPM or 870 RPM motors; four and five inch discharges.

NON-CLOG IMPELLER

The NON-CLOG Impeller built into this Screenless Sewage Pump supplies the ideal method of pumping sewage of other unscreened liquids containing solids. This design eliminates the necessity for expensive pneumatic ejectors and various other pumps requiring screening devices.



Successfully handles the tough jobs where other pumps fail.

Pumps of this design are still operating satisfactorily after 25 years in service.

Send for Bulletin C-900 or refer to **weil** catalog in Sweet's 1959 or Domestic Engineering Catalog Directory. Weil Representatives and Weil Engineers are available to help solve your waste pumping problems.

weil PUMP COMPANY

1514 No. Fremont St. Chicago 22, Illinois

EQUIPMENT DEVELOPMENTS

Continued

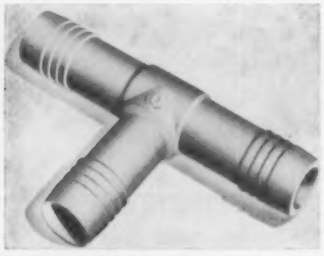
22 71st Ave., Glendale 27, L. I., N. Y.

Line includes plastic gaskets for stainless steel fittings, unions, and flanged joints. Gaskets said to be inert to chemicals used in industry; remain stable over wide temperature range.

Pipe Wrench . . .

. . . designed to work with compound leverage — *Ridge Tool Co., Dept. HPAC, Clark St., Elyria, Ohio.*

Pressure applied on handle of "Ridgid" wrench is multiplied by two as adjustable hook jaw turns pipe in one direction and offset chain vise head grips fitting, exerts equal pressure in opposite direction. By slipping removable chain vise head into place on side of handle, wrench can be used to tighten or loosen right or left hand threads. Available in four sizes for 2 to 8 in. pipe.



Plastic Fittings . . .

. . . of polypropylene designed for use with all flexible pipe — *Union Malleable Mfg. Co., Dept. HPAC, Clark St., Ashland, Ohio.*

"Poly-Plus Blue" fittings said to have high tensile, rigidity, and impact strength. Fittings are heat re-

this **WALKER** SHUR-FLO Draft Inducer-Regulator Unit...

ENDS DRAFT PROBLEMS RIGHT FROM THE START...

MODELS For Gas... Oil... and Solid Fuels!

"I don't fuss and fret with uncertain draft anymore since Walker brought out this low-priced draft inducer-regulator combination. Now, I install Walker inducers on all my jobs. That puts me way out ahead, because with good draft I know every job will be exactly right from the start."

THE INSIDE STORY OF SHUR-FLO EFFICIENCY

- Hi Volume Self-Feathering Fan
- Self-Cleaning Blades (No soot build-up)
- Stainless Steel Shaft, Hub, and Blades
- Quiet, burn-out proof motor
- Silicone oiled Bearings
- Extra heavy gauge galvanized steel construction
- Extra rigid mountings.

"Most Efficient Draft System Ever Made"

Say Heating Contractors, Architects, Home Owners

Draft problems are eliminated with a Walker Shur-Flo Control (Pats. Pending) in an oil, coal, or gas-fired installation because it's the SUREST DRAFT SYSTEM ever devised.

Here's an economical draft inducer that's a fool-proof answer to every draft problem from older heating installations to modern, low-roofed houses. You just install it and forget it. What could be better?

Moreover, the Walker Shur-Flo with fan operated draft inducer moves ONLY flue gases; does not suck in outside air. Building and home owners like the Shur-Flo because it runs quietly, costs less to operate, and requires little power. You'll like the Shur-Flo because it installs quickly at any angle—vertically, horizontally, or at a pitch—and virtually eliminates costly callbacks and corrections.

For full details, see your supplier or write direct

WALKER MFG. AND SALES CORP.

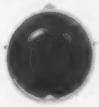
1720 Penn Street St. Joseph, Missouri

There's a Walker Draft Control Scientifically Designed to Meet Every Draft Problem Regardless of Fuel. 28,000,000 in Use Prove Efficiency. The Standard of Performance for the Industry.

ROYAL PURPLE for smaller central heating plants

TYPE 34 for larger special central heating

JUNIOR LINE central heating budget control

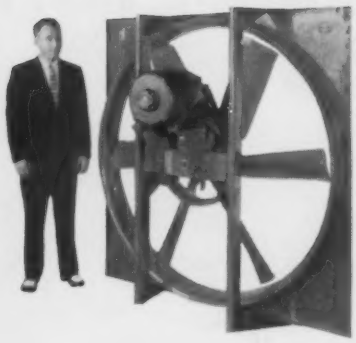


TYPE BB commercial and industrial control

DOUBLE SWING for gas fired equipment

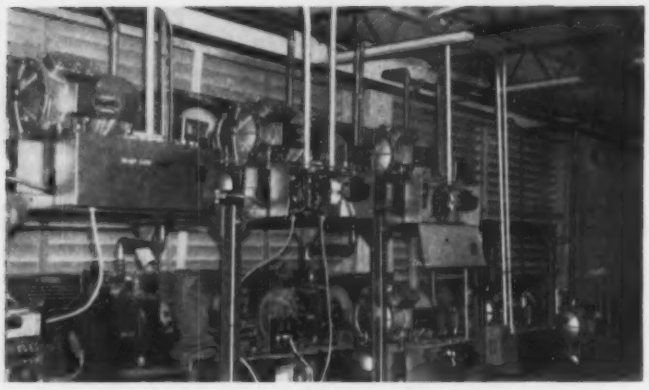
VENTURI CAP for heating and ventilating

SAVE AT WINN DIXIE FOOD STORES



COOLAIR
Heavy Duty Fans

Keep Winn-Dixie compressors operating at peak efficiency



Winn-Dixie is one of the Southeast's largest food chains—over 500 stores in 10 states. Air-cooled compressors like the ones shown in the photo are a vital part of supermarket food refrigeration and air conditioning equipment.

Winn-Dixie specifies Coolair ventilating fans to keep the compressors working at peak efficiency in its stores. These fans have the rugged dependability necessary for the job.

Factory-trained sales engineers in all principal cities are available for consultation on any ventilation or cooling problem. Write for the location of our sales office in your city or consult the yellow pages of the phone book.

American Coolair Corporation
P. O. Box 2300, Jacksonville 3, Florida

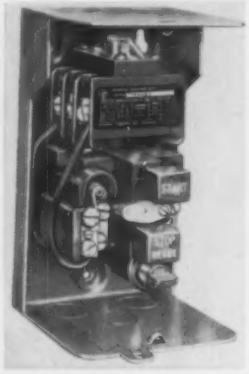
SEE OUR CATALOG IN SWEET'S
INDUSTRIAL CONSTRUCTION FILE

Charter Member Air Moving and Conditioning Association, Inc.

EQUIPMENT DEVELOPMENTS

Continued

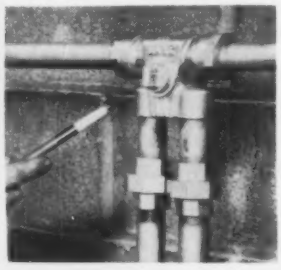
sistant, retaining strength at elevated temperatures and maintaining shapes at temperatures above 300 F. Fittings are chemically inert. Available in couplings, tees, ells, adapters in sizes from ½ to 2 in.



Manual Starters . . .

. . .with two moving parts in push button mechanism—*Furnas Electric Co., Dept. HPAC,* 1041 *McKee St., Batavia, Ill.*

New manual starters rated through 7½ hp, 440/550 volts a-c, and 2 hp, 230 volts d-c. Direct mechanical acting thermal overload operates independently of second overload or push button mechanism. Features cited: three or four poles; internal latch for stop position; pressure terminals; visible contacts and mechanisms; protected pushbuttons for added safety; heater coils as used on magnetic starters.



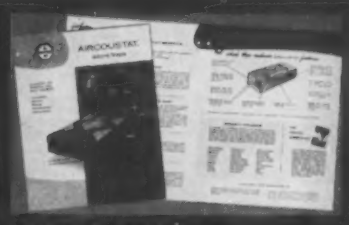
By-Pass Valve . . .

. . .designed to simplify installation, repair of commercial, industrial water conditioning equipment — *Clayton Mark & Co., Dept. HPAC,* 1900 *Dempster St., Evanston, Ill.*

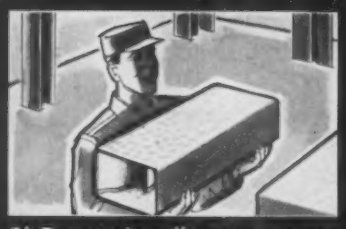
Threadless packer fittings on new

7 ways AIRCOUSTAT®
can save you time and money

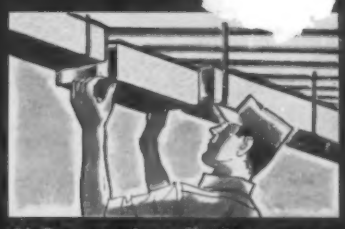
Sound Traps . . . w
Guaranteed Resul



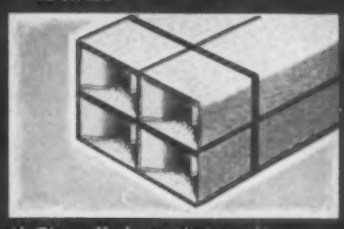
1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.



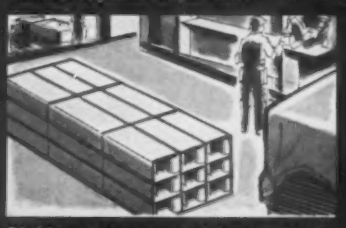
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



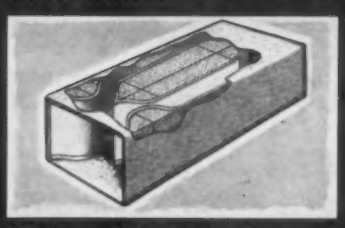
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.

7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3406 Scott Street, Baltimore 3, Maryland.

KOPPERS®

SOUND CONTROL

METAL PRODUCTS DIVISION

Engineered **Products Sold with** ***Service***

DO YOU KNOW WHY

FAIRBANKS VALVES

ARE BEING SPECIFIED AND INSTALLED IN THE NATION'S NEWEST MOST MODERN BUILDINGS?

UNIVERSITY HALLS, CORNELL UNIVERSITY, ITHACA, N. Y.
ARCHITECT AND ENGINEER: Chapman, Evans & Delehanty, New York, N. Y. GENERAL CONTRACTOR: C. E. Youngdahl & Co., Long Island City, N. Y. HEATING AND PLUMBING CONTRACTOR: Jamieson, McKinney Company, Ithaca, N. Y.

- Because Fairbanks Valves are Quality—DEPENDABLE—products.
- Because, over the past 67 years, long-lasting, trouble-free service has proven the DEPENDABILITY of Fairbanks Valves to the nation's leading consulting engineers, architects and contractors who have specified and installed these valves in the systems for which they were responsible. This acceptance of Fairbanks Valves is demonstrated by the fact that in over 50% of the new building construction described in an ENGINEERING NEWS-RECORD article "Office Building Boom Alters New York City Skyline", January 17, 1957, Fairbanks Valves were specified and installed.
- Because Fairbanks offers a full line of Bronze and Iron Body Valves for heating, piping and air conditioning systems.
- Because Fairbanks Valves are available the country over through stock carrying distributors in all the principal cities.

Do you have a copy of Fairbanks current Valve Catalog and Valve Comparison Chart? It will be a pleasure to send a copy of each to you.

THE Fairbanks COMPANY

EXECUTIVE OFFICE: 393 LAFAYETTE STREET, NEW YORK 3, NEW YORK

VALVES • DART UNIONS • CASTERS • TRUCKS • WHEELS

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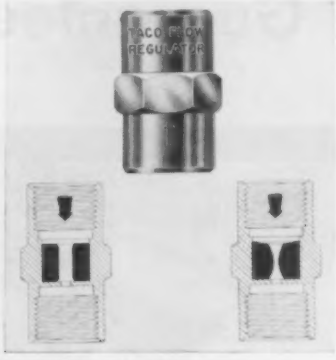
520 Atlantic Avenue Boston 10, Mass. | 2600 So. Throop St. Chicago 8, Ill. | 393 Lafayette Street New York 3, N. Y. | 15 Stanwix Street Pittsburgh 22, Pa. | 202 Division Street Rome, Ga.

Plants: Binghamton, N. Y. • Rome, Ga.

EQUIPMENT DEVELOPMENTS

Continued

valve said to eliminate need for unions, make use possible with ¾ in. iron pipe or 1 in. copper tubing. Other sizes available on request. Valve equipped with single, tapered turn plug which can direct water flow either to softener or directly into water supply. Unit suitable for cold water and hot water installations to 225 F.



Flow Regulators . . .

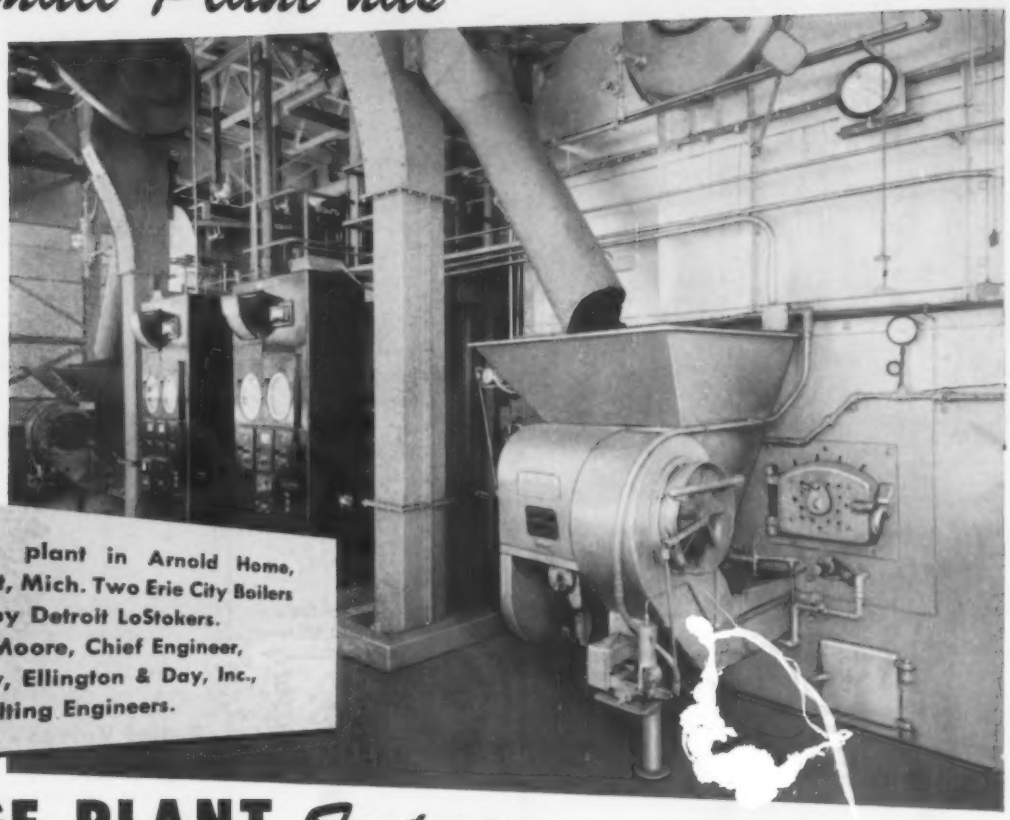
. . . in eight sizes from 2 to 8 gpm—*Taco Heaters, Inc., Dept. HPAC, 1160 Cranston St., Cranston 9, R. I.*

Flow regulator bodies are brass and tapped ½ in. for sizes through 4 gpm and ¾ in. for larger sizes. Control obtained by change in size and shape of orifice. Orifice is self-cleaning by continual flexing of rubber member. Said to be accurate to ±10 percent of rated size when used within range of 20 to 125 psi and suitable for temperatures to 160 F.

Dust Sampler . . .

. . . designed for taking dust samples from smoke stacks, process vents—*Gelman Instrument Co., Dept. HPAC, 233 Jefferson St., Chelsea, Mich.*

Small Plant has



Steam plant in Arnold Home, Detroit, Mich. Two Erie City Boilers fired by Detroit LoStokers. C. E. Moore, Chief Engineer, Harley, Ellington & Day, Inc., Consulting Engineers.

LARGE PLANT *Features . . .*

ONE DETROIT LoStoker DOES WORK DESIGNED FOR TWO

When the Arnold Home in Detroit was enlarged from 285 to 401 beds, a complete new steam plant was built. Two water tube boilers each of 9,000 pounds of steam per hour capacity were equipped with Detroit LoStokers. This was to furnish steam for a large laundry, the kitchens, water heating and all of the space heating.

It was expected that both boilers would be needed to carry the load in colder weather, especially after two more buildings with a total of 63 additional beds were added. However only one boiler was needed throughout one of the coldest winters on record in Detroit. One boiler was always on standby, ready for emergencies, extremely important in a home sheltering old and chronically ill people.

Either of the Detroit LoStokers easily met the firing requirements, including the rapid load fluctuations that occur when the laundry is in operation.

Stokers and boilers have full automatic control and complete instrumentation. Stoker hoppers are filled with coal by bucket elevators. Ash is dropped into a pit below the firing floor for periodic removal.

The Detroit LoStoker is a complete mechanical firing unit—ram type underfeed. It is efficient, dependable and built for long life. Requiring little power for operation it may be driven either by electric motor or steam turbine, under automatic control. Capacity range is 3,000 to 12,000 pounds of steam per hour. It is one of a complete line of Detroit stokers for boiler capacities up to 400,000 pounds of steam per hour.

Detroit Stokers save you money—ask us for details.

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG.—DETROIT 2, MICH.

DISTRICT OFFICES IN PRINCIPAL CITIES • WORKS AT MONROE, MICH.

THE MODERN FIRING METHOD IS COAL, WITH DETROIT STOKERS

Remington Stud Driver

The basic Power Unit...

Here's the single basic tool that gives you a new degree of on-the-job fastening versatility. Only *one* basic unit to buy—the Remington Model 455A—for all your fastening applications. Just choose the instantly interchangeable fastening attachment you need to do the job!

Plus choice of 4 fastening attachments...

K-1 1/4" & 3/8" Light-Duty Captive Stud Attachment uses 22 cal. Power Loads. Use where extra safety is needed.

K-2 1/4" Light-Duty Attachment uses 22 cal. Power Loads. Handles 80% of your fastening jobs.

K-3 3/8" Medium-Duty Attachment drives heavy-duty studs with inexpensive 22 cal. Power Loads.

K-4 3/8" Medium and Heavy-Duty Attachment. Uses both 22 and 32 cal. Power Loads. For toughest jobs.

offers greatest single-tool fastening versatility!

The Remington Stud Driver offers these exclusive features:

- Four fastening attachments for light, medium, heavy-duty work, including the special Captive Stud Attachment for extra-safe fastening. No other single tool can cover such a variety of applications.
- Medium-duty fastening—requiring ⅜" studs—can be done with low-cost 22 caliber Power Loads.
- Positive one or two-hand operation at operator's option . . . no buttons or release to hold while fastening.
- Greater variety of applications made possible with instantly interchangeable guards. These 4" square, hollow "safety guards" fit snugly over work, trap spall and dust. More than 40 types are available.

Send coupon for free booklet about the Remington Stud Driver—your best buy in powder-actuated fastening tools!

CHOOSE THE POWER MOST EFFICIENT FOR YOU. REMINGTON POWER TOOLS ARE AVAILABLE IN **AIR • ELECTRIC • GASOLINE AND POWDER-ACTUATED MODELS**

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Remington Arms Company, Inc., Bridgeport 2, Conn.
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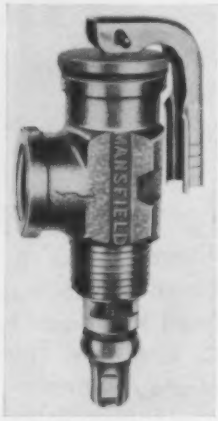
Please send—without obligation—catalogs on Remington Contractor & Industrial Tools checked below:
☐ Stud Drivers ☐ Air Tools ☐ Chain Saws
☐ Concrete Vibrators ☐ Electric Tools ☐ Flexible Shaft Machines

*Name*_____ *Position*____
*Company*_____
*Address*_____
*City*_____ *Zone*____ *State*____

EQUIPMENT DEVELOPMENTS

Continued

Dust sampler automatically collects 12 dust samples in sequence on 2 in. filter discs. Air may be sampled at rate of 2 to 4 cfm, depending on accessory vacuum pump used. Filter used may be glass fiber, cellulose, porous plastic membrane, or asbestos. For applications in air pollution control, industrial hygiene, process efficiency studies, etc.



Relief Valves . . .

. . . designed to protect against both excessive pressures and temperatures when inserted in hot water lines or tanks—*Mansfield Sanitary, Inc., Dept. HPAC, Perrysville, Ohio.*

Relief valves, "Model 496" and "Model 497," have thermo-setting elements to provide temperature relief action, give immediate closing of valve after 10 F drop in water temperature. Valves can be adjusted for pressures between 50 and 200 psi. "No. 497" equipped with combination test lever and adjusting key. Constructed with red brass bodies, valves have ratings of 150,000 Btu per hr. Male and female outlets are ½ in.

Valve Lubricant . . .

. . . formulated to work under varying water conditions—*Fairchild Camera and Instrument Corp., Dept. HPAC, Robbins Lane, Syosset, L. I., N. Y.*

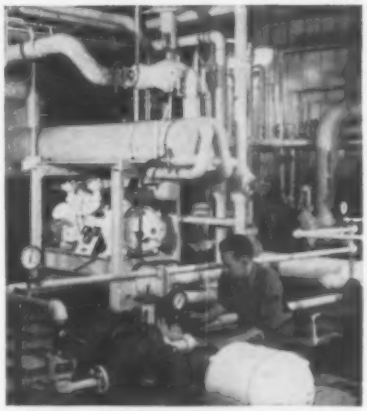
"Life Lube" is new process for coating mixing valves, allied equipment with permanent, corrosion re-

Long-term dependability...19.3 miles of Republic Steel Pipe installed in Chicago's Prudential Building

Over 100 thousand feet of Republic Steel Pipe was installed in this new, 41-story Chicago landmark (tallest roof on the Chicago skyline). *Steel*—because low-cost steel pipe is good for the life of any building. *Republic*—because M. J. Corboy Corporation, plumbing contractors, demands steel pipe with the highest possible degree of workability.

Constant quality control *guarantees* that workability. You enjoy easier bending, cutting, welding, and threading. What's more, you can rely on the strength of steel for long, unsupported runs; on the availability of steel for minimum variation in price or delivery; on the tight, galvanized coating of Republic Steel Pipe for stubborn resistance to corrosion and fabrication damage.

See for yourself! Your Republic distributor will give you a complete run-down on the immediate and long-term savings offered by Republic Steel Pipe. Call him today or write to Republic Steel Corporation, Dept. HP-7663, 1441 Republic Building, Cleveland 1, Ohio.

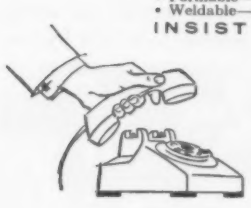


PRUDENTIAL BUILDING PLUMBING SPECIFICATIONS called for 77,710 feet of ½″ through 12″ galvanized steel pipe, plus 24,600 feet of 1″ through 12″ black steel pipe. Installation was handled by the M. J. Corboy Corporation, Chicago. Building architects were Naess & Murphy, also of Chicago.

STEEL PIPE IS FIRST CHOICE

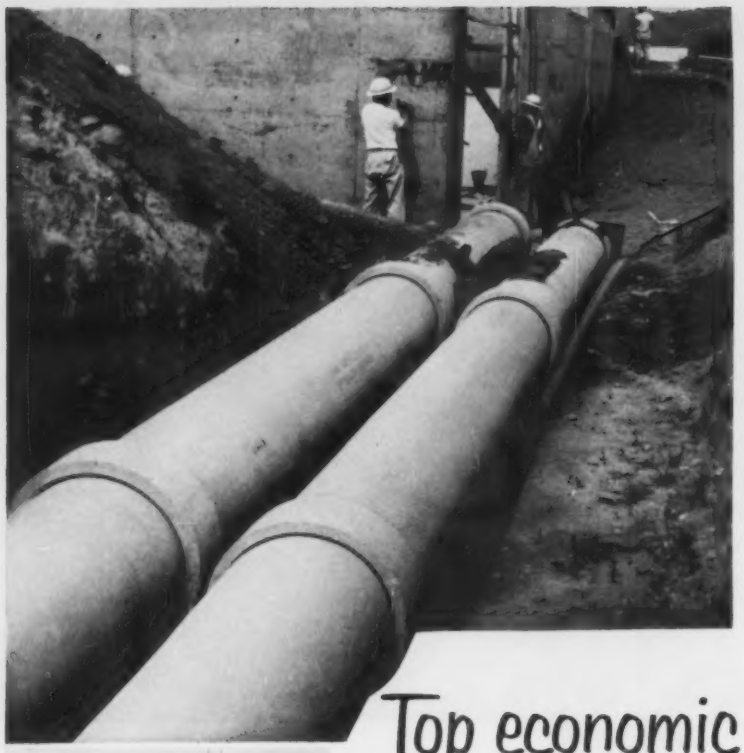
- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U.S.A.



CALL YOUR LOCAL REPUBLIC DISTRIBUTOR FOR QUICK DELIVERY OF STEEL PIPE

REPUBLIC *Steel Pipe*



Top economic life!...

Transite Pipe is strong, lightweight, easily handled . . . only larger diameters need handling equipment.

The Ring-Tite Coupling speeds and simplifies installation . . . assures lasting protection against leakage.

Transite Pipe is priced, designed and formulated to be today's best buy in factory water mains

When it comes to pressure pipe—you can pay more than you would for Transite®. Or you can pay less. But no other material gives you more than Transite in *economic life!* For Transite's every advantage—whether of price, installation or performance—contributes to maximum, long-term economy.

First, there's Transite's low cost. Then, there's its installation economy! Lightweight, easily handled, it needs fewer men to install it. Installation is made still faster, *surer* with Transite's Ring-Tite® Coupling that provides a tight, lasting seal.

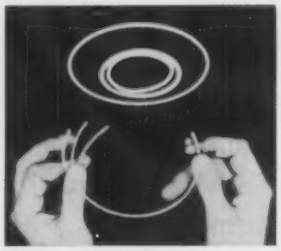
Once in operation, savings continue. Transite's smooth interior stays smooth—keeps pumping costs low, assures full water flow for the life of the pipeline. Made of asbestos-cement, Transite keeps maintenance to the barest minimum . . . it can't rust, is highly resistant to both corrosion and electrolytic action. Write for Pressure Pipe folder TR-160. Ask too about Transite Pipe for other plant services. Write Johns-Manville, Box 14-FA, New York 16, N.Y.

JOHNS-MANVILLE JM PRODUCTS

EQUIPMENT DEVELOPMENTS

Continued

sistant dry lubricant. Said to be especially suitable for fast moving mechanisms operating in wet conditions. Coating is approximately 0.0001 to 0.0002 in. thick, and is permanently bonded to metal surface, according to manufacturer.



Silicone O-Ring . . .

. . . designed for operating under severe conditions—*Fluoro-Plastics Inc., Div. of Flexrock Co., Dept. HPAC,* 2417 *Federal St., Philadelphia* 46.

Features of "Kel-F" silicone O-ring cited include: extreme chemical resistance; low coefficient of friction; good thermal characteristics; good resistance to extrusion; low compression set. Unit developed for operation in 100 to 300 F range. May be used at pressure of 1500 psi without back-up rings.

Btu Meter . . .

. . . designed to account for refrigeration or heating furnished by central air conditioning systems using chilled or hot water— *American Meter Co., Dept. HPAC, P. O. Box* 306, *Garland, Texas.*

"Model 200" Btu meter multiplies temperature change of water by flow.

Capitol Architect, J. George Stewart
Mechanical Contractor, Lloyd E. Mitchell, Inc., Baltimore
Consulting Engineer, Guy B. Panero, New York

Photo by Henry Rohlund,
Staff Photographer,
Washington Post & Times Herald

RIC-WIL

underground piping... ..."GOES TO WASHINGTON!"

The photograph shows the dismantling of the east front of the Capitol Building. The extension of the Capitol Building will be completed in 1960 and some 32 feet will be added to the over-all structure. The photograph also shows a section of new Ric-wiL pipe (foreground) that will handle the steam service.

For over 48 years Ric-wiL has supplied [illegible] distribution systems for institutions of all types, industrial plants in ever[illegible]ndustry and community central heating. These syste[illegible]en by over *eight million* lineal feet of installations [illegible]rite, wire or phone for literature on the many types of systems available.

See our catalog in Sweets

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED PREFABRI[illegible] INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

RAWL

SABER-TOOTH

DRILL-N-ANCHOR

fastest way to fasten to concrete

Anchor anything to concrete—easily, quickly, permanently—with Saber-Tooth, sure-holding heavy-duty masonry anchor that drills its own hole.

Put steel expander plug in drill end of Saber-Tooth, drive home... anchor expands over plug, at bottom of hole for greatest holding power.

See for yourself how easily you can anchor anything to concrete... send the coupon for free sample Saber-Tooth and full information.

It's a drill...and drills its own hole fast, even in hard concrete, with power-operated or hand hammer. Saber-Tooth's core action drills quickly. Drill and anchor are one...matching sizes is no problem. Save the cost of special drills, the time it takes to use, store and sharpen them.

It's an anchor...and holds fast: engineering tests demonstrate holding power up to 17,860 lbs. As you drive it into hole, anchor expands over plug...holding ridges around body resist pull-out. Saber-Tooth anchor withstands severe shock and vibration...double plating protects against rust, corrosion.

THE RAWLPLUG COMPANY, INC.
252 Petersville Road New Rochelle, N.Y.

Please rush my Saber-Tooth sample and complete facts.

Name.....

Firm.....

Address.....

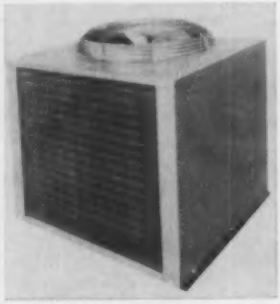
.....

R5

EQUIPMENT DEVELOPMENTS

Continued

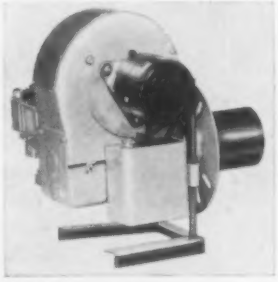
Two counters register heat transferred. Indication of temperature differential and water flow rate provided. Unit may be located up to 10 ft away from flow measuring element in any convenient position.



Condensing Unit . . .

. . . with 845 rpm motor and overlapping blade designed for quiet operation—*Fraser & Johnston Co., Dept. HPAC,* 1900 17*th St., San Francisco, Calif.*

Propeller type condensing unit equipped with receiver, discharge and liquid valves, high and low pressure switches, single condenser of multi-circuit type. Has fin spacing of 12 per in., large face area, solid steel base. Models in production include 2, 3, 4 ton sizes. Line will be expanded to include 2½, 3½, 4½ ton sizes.

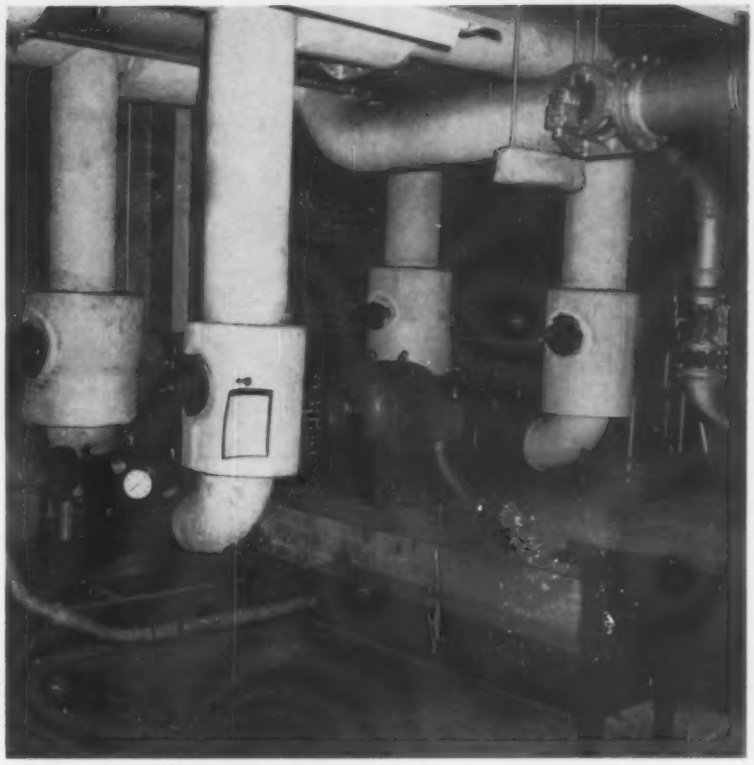


Inshot Gas Burners . . .

. . . said to be adaptable to warm air furnaces, hot water heaters, and boilers rated up to 400,000 Btu per hr —*Barber Mfg. Co., Dept. HPAC,* 1052 *E.* 134*th St., Cleveland* 10.

"Contractor" inshot gas burners available in two basic models with following inputs: 75,000 to 225,000 Btu per hr; 150,000 to 400,000 Btu

DeZURIK ..the BEST valve for air conditioning because.....



INSTALLATION COST IS LOW!

DeZurik Valves reduce the cost and improve the efficiency of any air conditioning installation! First of all, their initial cost is low . . . . lower than O S & Y valves. Tapping pipelines for pressure gages is unnecessary because DeZurik balancing valves are furnished with pressure gage connections.

Less piping support is required when DeZurik Valves are installed. Their light weight means easier . . . less expensive . . . installation. And they're easier to insulate, too. There's no large bonnet to cover.

The small bonnet and absence of a long stem makes more compact installations possible. Without crowding, piping galleries can be reduced in size . . . . another reduction in cost.

These DeZurik Valves were installed in 1956 on the chilled water and condenser water lines in the Lexington Building of the Baltimore Gas and Electric Company by Riggs Distler Company, Baltimore. DeZurik Valves are installed on shut off and balancing lines throughout this 1000 ton system.

Available in sizes ½" thru 20", in 2-way, 3-way or 4-way models with manual, on-off or positioning actuators. For more details, see the DeZurik representative near you or write Dept. AC.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Only DeZurik Valves give you all these advantages:

1. Easy Operation
2. Drip Tight Shut-off
3. Low Pressure Drop
4. Best for Balancing
5. Low Installation Cost
6. No Maintenance
7. Proved Record of Dependability
8. Compact Size
9. Economically Priced
10. Versatility beyond compare

Savannah Memorial Hospital, Savannah, Ga.

SAVES $50,300 IN AIR CONDITIONING ... with KoolShade Sunscreen

Solar heat control cuts cooling load by 74 tons!

Of the many features of Memorial Hospital, Savannah, Ga., none is more outstanding than its unusual air conditioning. It is primarily a 100%-fresh-air system!

Clearly superior to recirculating systems, 100%-fresh-air cooling has one problem: it requires far greater refrigeration tonnage. Hence it was economically imperative that Memorial seek out every practical means of reducing the load.

KoolShade Sunscreen — applied on south, east and west windows — was chosen immediately . . . and no wonder!

By controlling the solar heat transmission through glass, KoolShade actually reduced tonnage requirements by 74 tons! (Comparison: 2 inches of wall insulation was "worth" 72 tons.) Dollar savings, over and above the installed cost of the Koolshade, amounted to an estimated $50,300! And of course the building will continue to benefit from the lowered operation and maintenance costs.

Thus another great building proves it pays to *investigate* KoolShade Sunscreen!

Only Koolshade Sunscreen offers

- **unsurpassed shading efficiency**—keeps up to 87% of the sun's rays off windows during the hottest parts of the day: frees air conditioning systems from "hot spot" over-loads, gives relief from heat and glare, protects furnishings from sun-fading.
- **84% clear visibility**—better than with ordinary insect screening.
- **harmony with all architecture**
- **excellent insect protection**—no other screens needed on open windows.
- **virtually no maintenance**—strong metal fabric fully weatherized . . . never needs paint . . . lasts for years . . . withstands hard blows.

Send today

for this detailed and illustrated bulletin. And for expert help in cutting costs and sun problems, just request a call from a KoolShade engineer. No obligation or charge.

NEW . . . KoolShade Sunscreen and specially-designed KoolFrame Framing Members now Warranteed in writing!

KOOLSHADE®

REFLECTAL CORPORATION
A subsidiary of Borg-Warner Corp.
200 S. Michigan Ave., Dept. K-55
Chicago 4, Ill.

We'd like to know more about KoolShade. Without obligation, please send:
☐ Free literature
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Company .....
Address .....
City ..... Zone ..... State .....
9338

EQUIPMENT DEVELOPMENTS

Continued

per hr. Available in 5, 8, 10, 15 in. usable blast tube lengths with tube diameter of 4 in. Provided with either adjustable flange or stand mountings.

Equipment Briefs . . .

SIGN MARKING for marking glass fiber—*Gray Pantograph Engraving Co., Dept. HPAC, P. O. Box 72-436, Poteau, Okla.* "Gray Chemark II" process for marking glass fiber employs special inks said to make clear, durable marks on glass fiber.

SOLID FILM LUBRICANT developed to increase the life of moving parts operating in oil or grease—*Electrofilm, Inc., Dept. HPAC, P. O. Box 106, North Hollywood, Calif.* Solid film lubricant has following features cited by manufacturer: contains small particles of lead, tin, graphite as bearing materials; semi-porous nature absorbs oil, acts as reservoir against metal to metal contact under high loads; compatible with additives in modern oils, greases. Applications include use with spherical bearings, bearing cages, sleeve bearings, valve stems, others.

MOTOR INSULATION of silicone elastomer—*Allis Chalmers Mfg. Co., Dept. HPAC, 1171 S. 70th St., Milwaukee 1.* "Silco-Flex" insulation system for motor and generator stator windings developed to simplify, speed up maintenance and repairs.

HEAT RESISTANT GLASS designed to lessen or eliminate fade, heat, glare from sun—*American Glass Tinting Corp., Dept. HPAC, 1719 Sunset Blvd., Houston.* "Sun-X" glass tinting applied by patented flow process directly to windows already installed to form distortion-free, transparent shield. Said to eliminate 95 percent of glare, 82 percent of heat, 100 percent of glare. ⧺

INCREASED AIR FLOW..... SUPER-QUIET OPERATION!

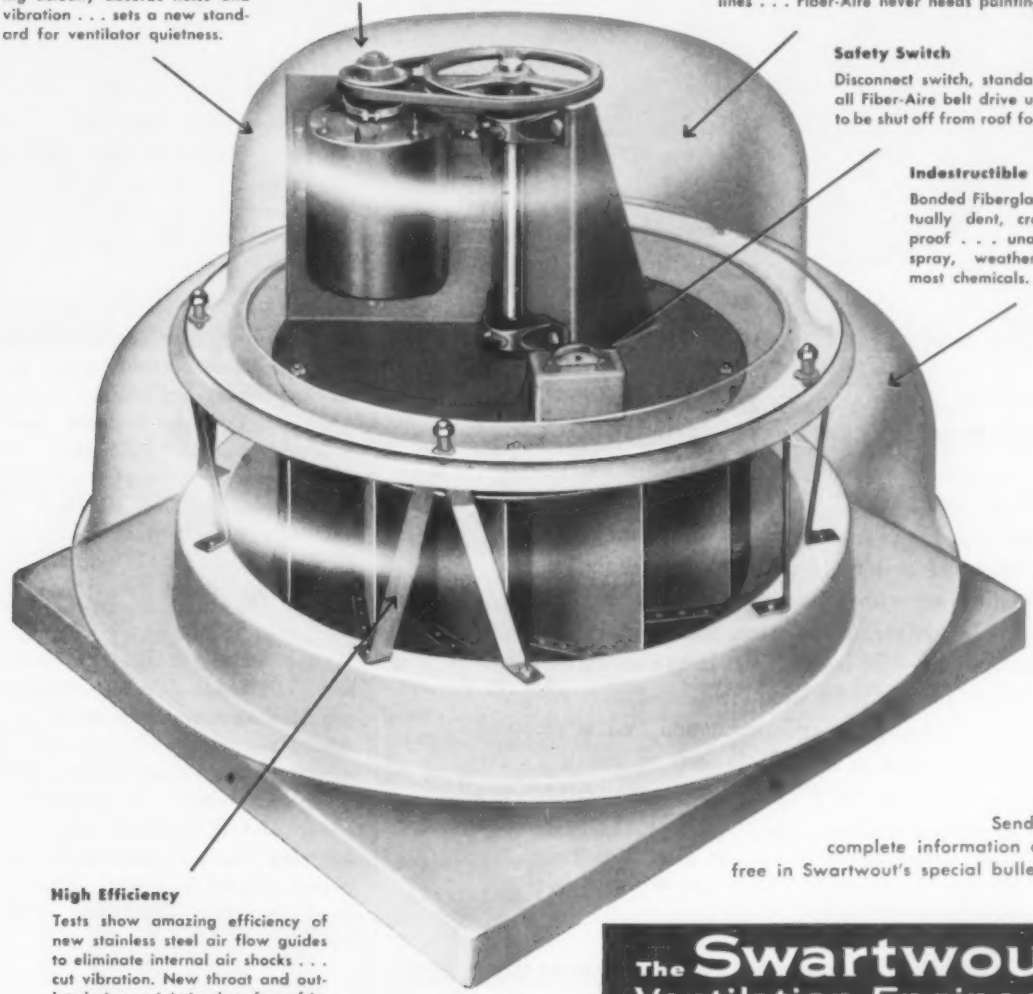
New Belt Drive "Fiber-Aires" with Bonded Fiberglas Housing*

Available now in 44 belt drive models
plus 17 direct drive units together providing capacities from
180 to 13,500 C.F.M.

Super Quiet
Fiber-Aire's all Fiberglas housing actually absorbs noise and vibration . . . sets a new standard for ventilator quietness.

Adjustable Capacity
Belt drive units feature easily adjustable sheaves . . . capacities are quickly changed, even after installation.

Flattering Design
Extra low contour and molded-in sky blue color, that "disappear" against the horizon, never mar clean architectural lines . . . Fiber-Aire never needs painting.



Safety Switch
Disconnect switch, standard equipment on all Fiber-Aire belt drive units, permits unit to be shut off from roof for absolute safety.

Indestructible
Bonded Fiberglas housing is virtually dent, crack and break proof . . . unaffected by salt spray, weather, fumes, and most chemicals.

High Efficiency
Tests show amazing efficiency of new stainless steel air flow guides to eliminate internal air shocks . . . cut vibration. New throat and outlet designs minimize loss from friction and turbulence.

Send now for
complete information available
free in Swartwout's special bulletin FA-2.

The Swartwout Co.
Ventilation Engineering
18568 Euclid Avenue Cleveland 12, Ohio

* TM Owens Corning Fiberglas Corporation

In Canada: Eastern Steel Products Ltd. 8 Bermondsey Road, Toronto, Ontario

United's Molded Cork Pipe Covering

FITS TIGHTER . . . GOES ON FASTER . . . PROVIDES MAXIMUM PROTECTION — When it comes to advantages, no other product can match *all* the benefits of United Cork's Molded Pipe Covering. Made from pure, clean, granulated cork, compressed and molded to exact size and shape and finished with a coating of plastic asphalt, it is an ideal covering for brine, ammonia, ice water, and cold lines of every kind. It has an extremely stable K factor over a wide low temperature range, will not rot or support combustion and is clean, sanitary and odor free. It is easy to install . . . and in the long run it's the least expensive.

Available in a wide variety of sizes and shapes from local stocks in key areas, coast to coast. Write today for more complete information as well as helpful installation data.

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Engineering offices or approved distributors in key cities — coast to coast.

RECENT TRADE LITERATURE . . .

▸ *ADJUSTABLE SPEED DRIVE*—Bulletin "No. 2750" describes company's redesigned "Adjusto-Spede" drive line in ratings of ¾ to 7½ hp. Drive designed to operate on a-c power and supply precise operating speeds for machine tools, process machinery, test equipment in ranges as high as 34:1 and for intermittent use from zero to full speed. Also intended for modernizing applications. Bulletin gives dimensions, engineering information, cutaway view. *Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee* 1.

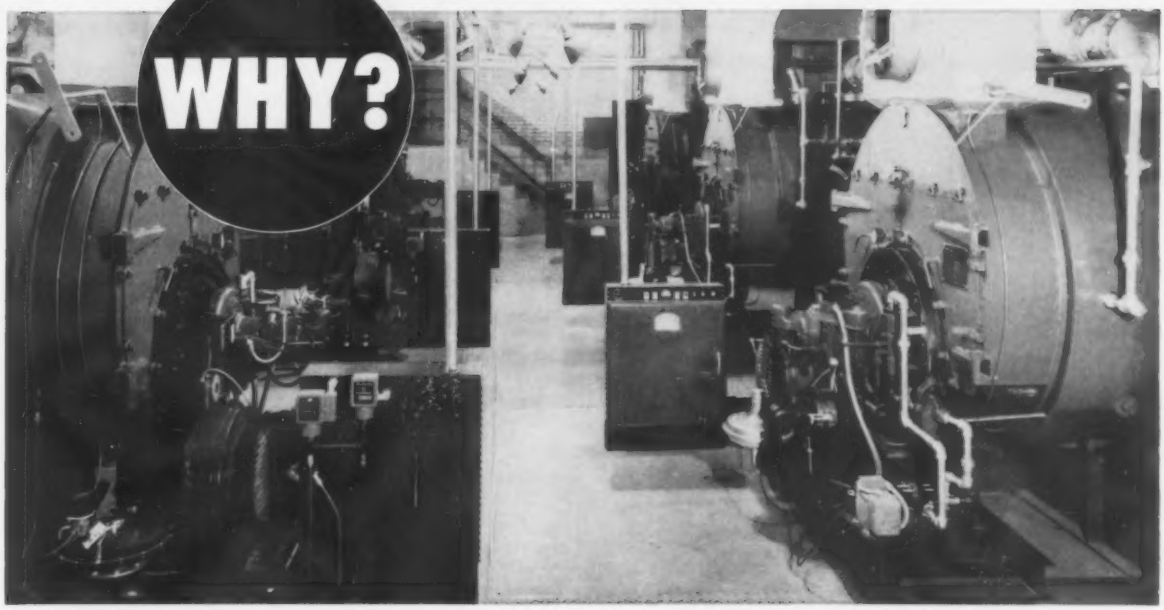
▸ *BTU METER*—New product specification sheet contains full information, specifications on "Model 913" Btu meter. System schematic illustration, photo, diagram illustrate sheet. *Hays Corp., Dept. HPAC, 800 E. Eighth St., Michigan City* 14, *Ind.*

▸ *CONCRETE DUCTS*—Brochure describes use of pre-cast hollow cell floor slabs for underfloor heating and air-conditioning applications in new American Concrete Institute headquarters building. Publication describes installation completely, giving photographs, detailed drawings of building's air distribution system. *Flexicore Co., Inc., Dept. HPAC, 1932 E. Monument Ave., Dayton* 1, *Ohio.*

▸ *CONDENSER TUBING*—New 10 page technical report presents text, tabular test data, performance curve graphs on light wall stainless steel condenser tubing installation in power plant. Operation, performance, corrosion resistance, installation techniques covered in report. *Carpenter Steel Co., Alloy Tube Div., Dept. HPAC, Union, N. J.*

▸ *CONTROL PANELS*—New 4 page bulletin "No. 159" describes packaged centralized control systems.

3 big boilers replaced by 6 small boiler-burner units



Six Petro package units replaced three big boilers in the Masonic Temple, Dayton, Ohio. Consulting Engineer—Schweiger, Heady and Associates, Dayton; Heating Contractor—Reiniger Plumbing & Heating Co., Dayton; Petro Distributor—Southmayd-Rankin Co., Dayton.

Advantages of Petro small package firing

Avoids wasteful use of boiler capacity
Outdoor thermostats put additional boilers "on the line" one at a time —or take them off—according to weather changes. These Petro units not only save fuel, but (quoting Mr. William C. Simpson, Executive Manager of the Masonic Temple Association of Dayton). "We do not have the extremes in building temperatures which were formerly experienced."

Fuel automatically selected by weather
Petro firing units automatically switch from gas to oil when outdoor temperature falls to 20 degrees. This relieves the gas lines of an extra load during periods of peak demand, and a lower gas rate is frequently given by the utility in such cases. Gas firing is automatically resumed as temperature rises. With full automatic control only minimum supervision is necessary.

No stack needed
Petro forced draft firing units eliminate high stacks. In fact, the only flue connection necessary is to a simple vent for the spent products of combustion.

DEPENDABLE Petro firing
Petro engineering stresses simple, non-temperamental design and rugged construction. These qualities, consistent for over half a century, have made Petro famous for thorough dependability.

Mail this coupon for more information

PETRO
T. M. REG. U. S. PAT. OFF.

Makers of quality heating and power equipment since 1903

PETRO
3332 West 106st Street, Cleveland 11, Ohio
(In Canada: 80 Ward Street, Toronto, Ontario)

Please send me literature and specifications on the money-saving Petro Package Unit.

Name _____
Company _____
Address _____
City _____ Zone ____ State _____

Beautiful Doctors Motel
St. Petersburg, Florida.

△

View of Vilter compressors that provide the refrigeration for the air conditioning system.

Comfortably Cool in a Warm Sunny Clime

Comfortably cool year 'round . . . inside, that is, at Doctors Motel, St. Petersburg, Florida. Dependable Vilter air conditioning is the answer.

There are 100 motel units at Doctors Motel and all are Vilter air conditioned. The system has a total capacity of 100 tons and is designed to keep the rooms at 78° F. and 50% relative humidity when outside temperature is 100° F. and humidity 90%.

This motel was opened to the public in December, 1956. From that time to the present *not a single adjustment has been required on the air conditioning system.* It is functioning perfectly and hasn't required any service work . . . a cost-saving installation. The owners are delighted with the performance of the Vilter system.

Vilter equipment installed at Doctors Motel includes two six-cylinder VMC Refrigerant-12 compressors; one shell and tube condenser, liquid receiver, water chiller and 100-ton heat exchanger.

Correct system layout, well-engineered equipment, careful fabrication, and floor testing of Vilter equipment pays off in efficient operation, long life and minimum maintenance. Why not call in Vilter for your refrigeration and air conditioning requirements.

Sold by Vilter Distributor, O'Dower Engineering Company, Kansas City 6, Mo.
Architects: Kivett, Myers & McCallum, Kansas City, Mo.
Mechanical Engineer: W. L. Cassell, Kansas City, Mo.

Write for this helpful bulletin to:
The Vilter Manufacturing Company, Dept. F-816
2217 S. First Street
Milwaukee 7, Wisconsin

Bulletin 820
Vilter VMC
Compressors

Vilter®
REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin
Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

RECENT TRADE LITERATURE
Continued

Publication presents custom-engineered control panels designed to combine wide range of sequencing, supervising, indicating and power controls for industrial processing heating applications. Bulletin also describes advantages of centralized control, features of control panels. *Protection Controls, Inc., Dept. HPAC, 6000 N. Leggett Ave., Chicago* 46.

▸ *CONTROL VALVE*—"Model 300" three and four way control valve is presented in 4 page leaflet, "Bulletin 300." Illustrations include cutaway views, diagrams. Text describes materials used, maintenance features, throttling characteristics, other features. *W. H. Nicholson and Co., Dept. HPAC, 12 Oregon St., Wilkes-Barre, Pa.*

▸ *EVAPORATIVE CONDENSERS*—"Dri-Fan" evaporative condenser "Catalog 30C8c" presents line with 60 different nominal ratings between 4.7 and 232 tons, now available for refrigerants Nos. 12 and 22. Features, operation, construction of units discussed in catalog. *Recold Corp., Dept. HPAC, 7250 E. Slauson Ave., Los Angeles* 22.

▸ *EXPANSION JOINT*—New 4 page bulletin describes company's complete line of packless corrugated expansion joints. Types illustrated, described include: self-equalizing, non-equalizing, flexible connectors, high pressure toroidal, universal, modified universal, hinged and gimbal, pressure balanced, pressure balanced universal expansion joints. *Zallea Brothers, Dept. HPAC, 815 Locust St., Wilmington* 99, *Del.*

▸ *FAN AND LIMIT CONTROLS*—New booklet "Form No. R-1630," entitled, "The Most Complete Line," covering fan and limit controls explains features, outlines action, operation, mounting of each series. Specifications, special features available for each series are listed. Each sec-

MR. PUMP DEALER:
I'M A **REDI-PAK** PUMP...

WITH *READY PROFITS FOR YOU!*

This is one of the twenty-two end suction pumps from the famous Peerless Fluidyne pump line – INDIVIDUALLY PACKAGED and ready to go! Immediately available in sizes from 1 to 15 hp, these popular pumps are making friends of users and money for dealers who handle them! They're *versatile;* will fit all kinds of general purpose duties. They're *compact;* helping make the most of space in any layout. They're *easy to maintain,* require no special tools for routine care. They're *dependable,* operate on continuous or intermittent duty at any mounting angle. They're *efficient;* choose them from the performance charts to fit the problem. Request complete information.

PEERLESS *Fluidyne*® REDI-PAK PUMPS

PREPACKED and ready for immediate service, this Fluidyne is one of the 22 popularly sized pumps, from 1 to 15 HP, that comprise the quickly available, economical REDI-PAK line.

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HPAC

FOR A NEW PERSPECTIVE ON HEATING, COOLING and AIR CONDITIONING EQUIPMENT

Young | SPECIALISTS IN HEATING, COOLING and AIR CONDITIONING

SEE WHAT THE YOUNG APPROACH TO ECONOMY THROUGH QUALITY CAN DO FOR YOU!

Top design and engineering by Young Specialists, combined with modern manufacturing methods, makes Young's line of heating, cooling and air conditioning products outstanding for value and performance.

Check Young's wide line of products, listed at the right. Write for catalogs on those which interest you. Compare performance charts, ratings and features with competitive products and you'll find that Young provides the ultimate in comfort and convenience at low cost. Young products offer a sound solution to heating, cooling and air conditioning problems for practically every type of residential, commercial and industrial building. Check and compare—then call Young.

YOUNG RADIATOR COMPANY
Racine, Wisconsin—Dept. 519-F

New Central Station Air Conditioning Units
Catalog No. 7558

New Remote Roomaire® Conditioning Units
Catalog No. 7758

New Vertiflow® Unit Heater
Catalog No. 2658

New Heating Coils
Catalog No. 4558

New Cooling Coils
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Other Lines

Cabinet Unit Heaters
Catalog No. 6556-A

Gas Fired Unit Heaters
Catalog 2758

Horizontal Unit Heaters
Catalog 2557

Convector Radiators
Catalog Nos. 4049-A & 4150

Perimaheat® Baseboard Convectors
Catalog No. 4354-A

RECENT TRADE LITERATURE
Continued

tion includes explanation of individual control applications. *White-Rodgers Co., Dept. HPAC,* 1209 *Cass Ave,. St. Louis* 6.

▸ *FIRE EXTINGUISHING SYSTEMS*—New 28 page brochure covers nine types of interior fire extinguishing systems, portable extinguishers, cabinets, other fire control products. Publication is fully illustrated, diagrammed, with specifications, operation descriptions given throughout in text. *Fyr-Fyter Co., Dept. HPAC,* 221 *Crane St., Dayton.*

▸ *FLOW RATE CALIBRATOR*—Volumetric displacement calibration stand developed for calibrating small flow devices to accuracies within 0.2 percent. Fluid measured, automatically timed as it passes through unit being calibrated, then into collecting chamber. "Design Specification Sheet SS-902" describes product in detail. *Brooks Rotameter Co., Dept. HPAC, P. O. Box* 432, *Lansdale, Pa.*

▸ *HANGAR HEATING*—New, 20 page illustrated bulletin "No. HA-100" describes aviation hangar heating installations utilizing overhead revolving discharge heaters. Bulletin discusses problems, solutions in hangar heating, shows typical installations in illustrations, offers typical layoute with engineering data. *L. J. Wing Mfg. Co., Dept. HPAC,* 140 *Vreeland Mills Rd., Linden, N. J.*

▸ *HEAT EXCHANGERS*—New brochure, "Form No. 5003," describes advantages of using company's "Inner-Fin" coils in space and weight saving problems. "Liquid-to-air" and "air-to-air" applications of finned radiators for airborne, mobile, or fixed station use described. *Dunham-Bush, Inc., Dept. HPAC,* 179 *South St., West Hartford, Conn.*

▸ *HIGH VELOCITY FILE*—File of information discusses use of high ve-

Choice of the leaders: K&M high-pressure insulations

Where temperatures range up to 1350°F., you'll find leaders in all fields where heat control is important turning to "K&M" KaytherM. Because they can be *sure* with "K&M" KaytherM. There's no better insulation of its type. In low-pressure insulations, it does everything "85% Magnesia" does, and d[illegible]s it better. Composed of diatomaceous silica and quali[illegible] asbestos fibers, "K&M" KaytherM is easily worked on the job, chemically stable, strong, and lightweight. Cement adheres readily.

"K&M" also manufactures a full line of Low-Pressure Insulations in pipe, sheet, and block forms, as well as in cements for all types of applications.

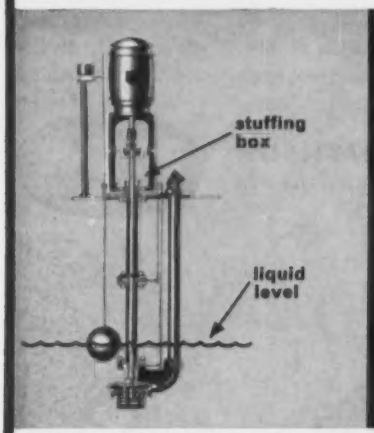
Whatever your insulation problems, you can rely on the eighty-five years of asbestos engineering that lies behind every "K&M" asbestos product.

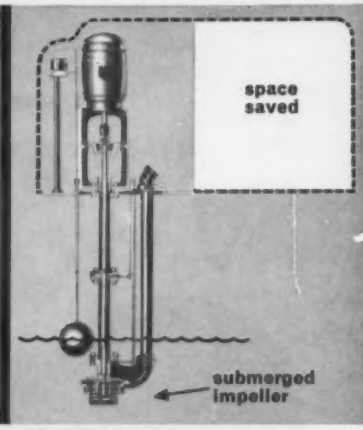
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K·M
BEST IN ASBESTOS

you stop leakage, save space, and cut costs with Yeomans

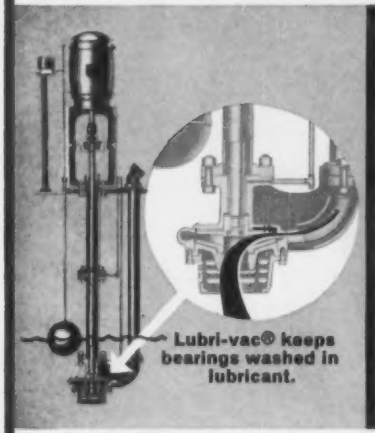
VERTICAL WET PIT PUMPS

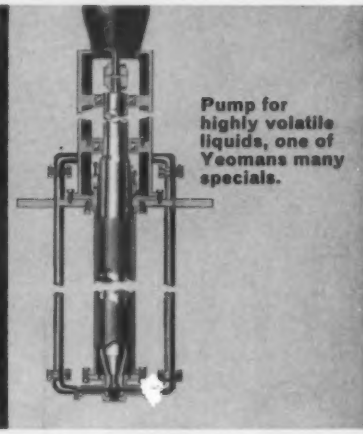




ELIMINATE LEAKAGE. Stuffing boxes and seals are not under liquid pressure. With the Yeomans Vertical Wet Pit Pump there are no costly, annoying, or dangerous liquid leaks, as with horizontal pumps.

SAVE FLOOR SPACE. They use less than half the space required by horizontal pumps. Also, no priming equipment is needed as with suction lift horizontals. Impellers are submerged in the liquid ready for service.





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P-5916

RECENT TRADE LITERATURE

Continued

locity air distribution systems. Subjects covered include: nature of high velocity air distribution; applications; duct design; duct construction; temperature control for high velocity systems. *Barber-Colman Co., Dept. HPAC, Rock St., Rockford, Ill.*

▸ *INDUCED DRAFT FANS*—Features, capabilities of new induced draft fan discussed in new 4 page bulletin. Publication also describes air cooled fan wheel designed to permit operation in temperatures to 800 F. Schematic drawings, dimensioned diagrams, photographs illustrate bulletin. *Lehigh Fan & Blower Div., Fuller Co., Dept. HPAC,* 124 *Bridge St., Catasauqua, Pa.*

▸ *INDUSTRIAL SPRAY NOZZLES*—Catalog "No. 59" describes manufacturer's line of spray nozzles for industrial applications. Each type illustrated in photo, diagram. Capacities, dimensions given in table form. Text describes each type, providing details on spray characteristics, construction, materials, applications. *Wm. Steinen Mfg. Co., Industrial Nozzle Div., Dept. HPAC,* 43 *Bruen St., Newark* 5, *N. J.*

▸ *INSTANTANEOUS WATER HEATERS*—Heating water with steam using "Type SU" instantaneous water heaters described in "Bulletin No. S1-159." Publication also lists ratings for temperature rises over wide range of steam pressures. Ratings given for service and feed water heaters. *Bell & Gossett Co., Dept. HPAC,* 8200 *N. Austin Ave., Morton Grove, Ill.*

▸ *MOTOR CONTROLS SELECTOR CHART*—Chart designed to simplify, speed selection and ordering of motor controls. Includes information on motor control ratings, sizes, features, catalog numbers, ordering instructions. *Arrow-Hart & Hegeman Electric Co., Industrial Control Div., Dept. HPAC,* 103 *Hawthorn St., Hartford* 6, *Conn.*

In Bulletin No. 6050 on P-K forced boiler water heat exchangers complete capacity tables are provided, grouped by temperature ranges. Pressure drop is shown for each capacity. Dimensional data supplied

Catalog No. 19 covers P-K storage water heaters in plain steel, copper-lined, copper silicon, Pre-Krete lined, clad and galvanized. In addition to tabular data on capacities, weight and dimensions, this book carries a handy conversion table to determine capacities of heating sections with various temperature ranges and steam pressures.

Catalog No. 202 describes P-K instantaneous water heaters. Contains capacity tables covering two, four and six pass design. Tables are grouped by steam pressures ranging from 0 to 100 psi. Inlet and outlet temperatures are listed with hot water capacities.

In this P-K Bulletin No. 303-A, covering convertors for forced circulation water heating systems, capacity tables include the usual ranges for standard water heating systems. Also included are general ranges for radiant heating systems.

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▸ *MOTOR SELECTION DATA*—Concise selection data on a-c motors from 1 to 200 hp provided in 12 page booklet. Included are explanations of NEMA design classes, speed-frequency relationship, current and torque values, dimension information for standard frames and mechanical modifications for all frame sizes from 185 through 6085. *Reliance Electric and Engineering Co., Dept. HPAC,* 24701 *Euclid Ave., Cleveland* 17.

▸ *MILLIVOLTMETERS*—New 28 page catalog covers operating principles, specifications, features, ordering information on non-control and control millivoltmeters. Catalog includes information on all of company's control models. *Minneapolis-Honeywell Regulator Co., Industrial Div., Dept. HPAC, Wayne and Windrim Aves., Philadelphia* 44.

▸ *NOISE CONTROL*—Bulletin "IT-59" gives details on company's "Lo-Stat" and standard sound traps, "Interwall" sound barriers, acoustical services. Sound traps available in four standard sizes used singly, in tandem or in multiples for required sound attenuation. *Insul-Coustic Corp., Dept. HPAC,* 42-23 54*th Rd., Maspeth* 78, *N. Y.*

▸ *PACKAGED BOILER*—New 8 page publication describes new hot water heating boiler available in 18 sizes from 500,000 to 20 million Btu per hr. Boiler especially designed for forced circulation hot water systems for institutional, commercial and industrial space heating. Curves, tables, charts, photos illustrate text. *Orr & Sembower, Inc., Dept. HPAC, Box* 1138, *Reading, Pa.*

▸ *PRECAST CONCRETE DUCTS*—New 1959 catalog describes precast concrete floor and roof system. Included in folder are photographs, design data, detail drawings on use of ducts with steel and reinforced concrete frames, plumbing, heating and

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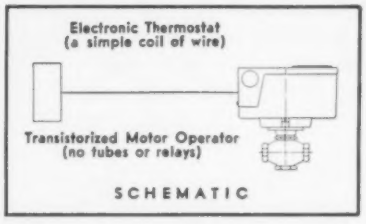

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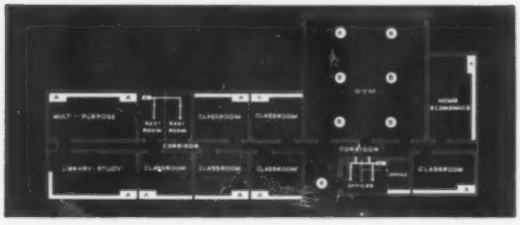

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Pre-wired, partially assembled Norman Heating and Ventilating Systems are quickly installed room by room. In new schools, like the Mary G. Hogsett school, Norman Systems eliminate expensive boiler rooms, chimneys and tunnels. The $0.876 figure is typical of the low installation costs being realized across the nation. Norman economy grows with the school . . . individual classroom systems are added as required without costly revamping of central system.

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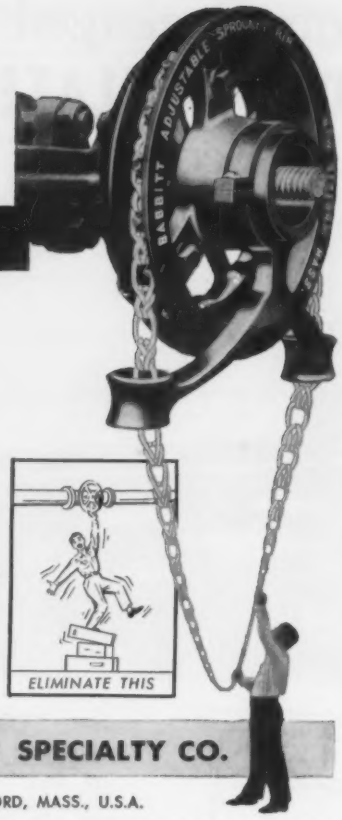

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RECENT TRADE LITERATURE
Continued

cooling systems and electrical wiring. *Flexicore Co., Inc., Dept. HPAC,* 1932 *E. Monument Ave., Dayton* 1.

▸ *PRESSURE REGULATOR PILOT*—Catalog sheet describes "Fig. 8000" pressure regulator pilot designed to regulate, reduce pressure of steam, air, gases, liquids within fractions of 1 lb in single stage. Pilot uses 20 to 75 psi air or water pressure to actuate control valve. Used with single or double seat valves, ½ to 12 in. Catalog sheet contains photo, diagram of valve as well as features, applications, installation information. *Atlas Valve Co., Dept. HPAC,* 280 *South St., Newark* 5.

▸ *PRESSURE TRANSMITTER*—Bulletin "WG-1824, Supplement A" describes differential pressure transmitter recently developed by company. Publication gives applications, operation, construction details, advantages, operating specifications. *Yarnall-Waring Co., Dept. HPAC, Chestnut Hill, Philadelphia* 18.

▸ *PROPORTIONING PUMPS*—New bulletin "No. 1140.20A-1" gives information on use, application of "Model 1140 Proportioners Ajust-O-Feeder" designed for chemical and industrial fluid proportioning over wide range of capacities and pressures. The 4 page publication offers text, photos, cutaway drawings showing new fluid end construction and "Vane Guide" check valves. Detailed capacity chart gives pressure ratings, specifications, dimensions, *B-I-F Industries, Inc. Dept. HPAC,* 345 *Harris Ave., Providence* 1, *R. I.*

▸ *PUMPS*—New 1959 catalog has detailed illustrations of several pump installations in addition to presentation of complete line of domestic and industrial submersible pumps. Catalog lists physical dimensions, pumping capacities, electrical data, specific features for each of company's pumps. *Kenco Pump Div., American Crucible Products Co., Dept. HPAC,* 1305 *Oberlin Ave., Lorain, Ohio.*

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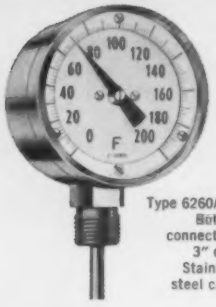

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They respond quickly and accurately to all temperature changes, whether mounted on a blower in a basement or on air conditioning equipment on a roof. American Bi-Metal Dial Thermometers combine superior resistance to vibration with the greatest sensitivity in bi-metal actuation. Two other advantages provide extra value:

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Type 6360AH – Back connection. 3" and 5" dials. Stainless steel case.

Type 6060AH–"Every Angle" connection permits setting at any point within 180° on two axes. 5" dial. Stainless steel case.

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RECENT TRADE LITERATURE

Continued

▸ *REFRIGERATION OILS*—Bulletin "A-3895" gives information on selection and use of lubricating oils for refrigeration units. Adapted from 10 page article by Edgar A. Ross, company engineering consultant, material covers essential characteristics of refrigeration oils; refinement techniques; significance of properties; effect of refrigeration on oils; lubrication of industrial compressors; splash lubrication; lubrication of bearings and of air conditioning equipment. *Sun Oil Co., Industrial Products Div., Dept. HPAC,* 1608 *Walnut St., Philadelphia* 3.

▸ *REGISTERS AND GRILLES*—New 20 page catalog "59 C. R." describes company's complete line of commercial registers and grilles. Large product illustrations, complete engineering details, specifications of products included. *Air Control Products, Inc., Dept. HPAC, Coopersville, Mich.*

▸ *REGISTERS, DIFFUSERS*—New catalog designed for easy, accurate selection of all types of company's air diffusion equipment. New 58 page publication has color key for easier identification of company's four major product groups. Products include wall and ceiling type supply grilles and registers; ceiling and door type return grilles and registers; extruded aluminum airline grilles; accessories and miscellaneous products. Each section has detailed selection tables, illustrations of models within product category. *Waterloo Register Co., Inc. Dept. HPAC, P. O. Box* 72, *Waterloo, Iowa.*

▸ *ROOF VENTILATORS*—Bulletin "No. 246" presents firm's new line of spun roof ventilators. Bulletin contains performance tables with model numbers, hp ratings, rpm information, wheel diameters, dimensions and cfm capacities. Applications, general construction features, optional features, ratings, motor construction also included. *Peerless Electric Co., Fan and Blower Div., Dept. HPAC,* 1401 *W. Market St., Warren, Ohio.*

▸ *ROTARY BURNERS*—Bulletins "No. 405," "No. 415," "No. 420" describe separate aspects of construction, operation, features of manufacturer's horizontal rotary burners. Each bulletin is illustrated with photos, diagrams. Specifications, dimensions given in text. *Preferred Utilities Mfg. Corp., Dept. HPAC,* 41 *E.* 42*nd St., New York* 17.

▸ *SOLDERING OF ALUMINUM*—New booklet presents latest information available on aluminum solder-

RECENT TRADE LITERATURE

Continued

ing. Reference includes data on soldering fluxes, irons, flames, gives information on actual soldering methods such as hot plate, dip, furnace, friction, glass fiber brush, ultrasonic operations. Types, properties of aluminum solders explained, with corrosion of soldered joints and performance in aluminum. Text illustrated with diagrams. *Reynolds Metals Co., Dept. HPAC, Box* 2346, *Richmond* 18, *Va.*

▸ *STEEL BOILERS*—Illustrated 48 page catalog covers manufacturer's complete line of steel boilers. Each model described, illustrated in photo, diagrams with complete specifications given. Photo of site of actual installation for each model included in catalog. *William Zingheim Co., Delta Steel Boiler Div., Dept. HPAC,* 5050 *Lake St., Chicago* 44.

▸ *SUBMERSIBLE PUMP*—Bulletin "No. 6700-2" presents company's new submersible pump. Publication cover features including: fatted stainless steel shaft; lightweight diffusers; self-aligning, taper-locking spline shaft coupling; three-wire cable with special waterproof connectors. Bulletin illustrated with photo, installation drawing. *Deming Co., Dept. HPAC,* 14 *Aetna St., Salem, Ohio.*

▸ *TEMPERATURE CONTROLS*—"Thermoswitch" controls and mounting wells described in new 8 page booklet "MC-177." Publication includes description of operation of units on differential expansion of metals, complete operating specifications and dimensions, available modifications, special features. *Fenwal, Inc., Dept. HPAC, Pleasant St., Ashland, Mass.*

▸ *TIME SWITCHES*—New catalog "No. 159" has complete section devoted to explanation of switching and timing. Typical wiring diagrams, explanation provided to help selection of right switch action. Specifications, photo illustrations also included. *Tork Time Controls, Inc., Dept. HPAC,* 33 *Grove St., Mt. Vernon, N. Y.*

▸ *VACUUM GAGES*—New catalog "No. 525B" presents company's line of indicating gages in 3½, 4, 6, 8½ in. dial sizes in ranges of from 10 in. WG to 10,000 psi. New "SG" safety gage for use with hazardous conditions offered. Recording pressure gages in 8, 10 and 12 in. chart sizes also shown. *Weksler Instrument Corp., Dept. HPAC,* 195 *E. Merrick Rd., Freeport, L. I., N. Y.*

▸ *VACUUM VALVE*—Engineering data sheet gives features, specifications, ordering information on manu-

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facturer's "Nupro" high vacuum valve. Illustrated with photos, drawings and graph. *Nuclear Products Co., Dept. HPAC, 15635 Saranac Rd., Cleveland 10.*

▸ *VALVES, FITTINGS, SUPPLIES*—Illustrated, new catalog lists manufacturer's line of valves, fittings, supplies for refrigeration applications. Pipe nipples, hanger fittings, other new items have been added to company's new catalog. Tables on refrigerants, brines, steel pipe, copper and steel tubes, storage temperatures, mechanical equivalents, thermometer scales included in back of book. *Frick Co., Dept. HPAC, Waynesboro, Pa.*

▸ *VARIABLE SPEED DRIVES*—New 8 page bulletin "G-5812" describes line of variable speed drives designed to provide infinitely adjustable output speeds from constant rpm motor source operating from standard a-c circuits. Publication includes mechanical construction features, condensed drive specifications, available speed variations, accessories. *Reeves Pulley Co., Div. of Reliance Electric and Engineering Co., Dept. HPAC, Columbus, Ind.*

▸ *VIBRATION CONTROL*—Engineering data folder provides information on simplified machine installation and vibration control. Questions pertaining to relocation of machinery, advantages and applications of company's "Unisorb" cement answered in publication. Directions given for a "Do-it-yourself" leveling mount, description of "Unisorb Level-Rite" and "Unisorb Level-Rite Model 200" also given. *Unisorb Div., Felters Co., Dept. HPAC, 210 South St., Boston, Mass.*

▸ *VERTICAL STEAM BOILERS*—Bulletin "No. 5215" explains advantages of manufacturer's line of vertical steam boilers. Features of "Type H" vertical boilers include: simple design; quietness; fully automatic operation. *Sellers Engineering Co., Dept. HPAC, 4876 N. Clark St., Chicago 40.*

▸ *WELDING FITTINGS*—"Form No. 593" covers company's expanded line of seamless carbon steel welding fittings. Publication contains 20 pages of specification tables, product photos, engineering drawings, ASA tables, manufacturing details, other engineering product information. *Dresser Mfg. Div., Dresser Industries, Inc., Dept. HPAC, 49 Fisher Ave., Bradford, Pa.*

▸ *WELDING FITTINGS AND FLANGES*—Technical Bulletin "F-DC-263" gives dimensions, diagrams of company's welding fittings, forged steel flanges in 6 in. size. Specifications are given. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Milwaukee 46.* ⧺

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Simply depress lever and tongs grip metal at pre-determined pressure, switch is turned on and weld sequence timer is actuated for precise period set on control dial. Thus, every weld is identical until timer adjustment is changed. Pilot light indicates when welder is connected.

This advanced design plus light weight and wide selection of tongs make the new Miller Lectro Spot the finest welder of its type.

Available in three styles: 115v or 230v, 1.5 KVA models for work to 1/8" thickness, both weigh 29 lbs.; 230v, 2.5 KVA model for mild steel to 5/32", weighs 37 lbs.

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MSA reports on: A Vocabulary of Airborne Particulate Hazards

MSA hopes to stimulate through this discussion a clearer and more orderly interpretation of airborne particulate hazards. This report is directed to those of you in industry who have something to do with the moving and filtering of large volumes of air. A general knowledge of these terms will help us all communicate more effectively. Write us for help in your system recommendations.

DUSTS—Let's define dusts as mechanically generated particulate matter (usually found in the harmful size range of from 1 to 10 microns in diameter). *Nuisance or irritating dusts* have no known specific physiological response. *Fibrosis producing dusts* are local offenders, causing growth of scar tissue in lungs. *Toxic dusts* are general offenders, being systemic poisons. Toxic dusts are of two types: (1) not significantly more toxic than lead: limit of U. S. Bureau of Mines Schedule #21; and (2) more toxic than lead: materials such as Beryllium. *Radioactive dusts* include radioisotopes and inert carriers.

MISTS AND FOGS—Under this category falls liquid particulate (usually found in size ranges of from 5 to 100 microns).

METAL FUMES—Here lie the chemically generated solid particulates (usually generated in a size range of from 0.1 to 1.0 microns).

SMOKES—These particulates are also chemically generated but of organic origin (usually formed in a size range of from 0.01 to 0.3 microns).

LIVING ORGANISMS—Harmful living particulates are classified under this heading. And they in turn include:

Bacteria: one-celled micro-organisms of ½ to 15 microns diameter size range. *Bacteriaphages:* .01 to .5 micron in diameter, depending on degree of clumping. *Virus:* .001 or smaller to 0.3 micron in diameter. *Pollen:* microspores from seed plants (usually found in the size range of from 10 to 70 microns in diameter). *Spores:* reproductive bodies of plants and some one-celled animals about same size as bacteria.

M-S-A® UltraAire* Space Filter

Light weight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pre-tested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.

M-S-A® Cylindrical-Type UltraAire* Space Filter

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems. Weighs only one pound. Easy to handle. Inexpensive to ship.

M-S-A® Dustfoe* Space Filter

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Stain Rating.

M-S-A® Air-O-Kay* Prefilter

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

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Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations.

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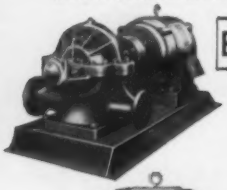
Cooling Towers
Water Treatment
Water Circulation
Brine Service, Etc.

C Hot Water Circulation
Ice Water or Brine
Clear Water
Boilers
Booster Service, Etc.

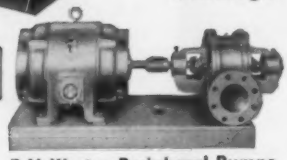
D Hot and Cold Liquids
Refrigerants
Boiler Feed
Cooling Towers

Then You'll Find Your Best Answer Here—

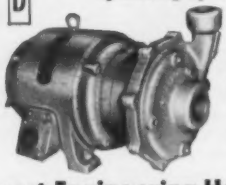
A **F-M Pomona Water-Lubricated Turbine Pumps**
Easily installed, easy to adjust for varying field conditions. Available with wide choice of drivers.



B **F-M Split-Case Centrifugal Pumps**
Capacities, pressures and sizes for any requirements. Single-stage or multistage.



C **F-M Westco Peripheral Pumps**
Capacities to 200 gpm. Pressures to 900 ft. Sizes 1¼" through 2½". Horizontal single-stage or multistage. Develops high pressure at normal operating speeds.



D **F-M Builtogether Centrifugal Pumps**
Capacities to 900 gpm. Pressures to 525 ft. Sizes ¾" through 5". Single-stage or multistage.

FREE! Expert Engineering Help at Your Service

Be *sure* of low-cost, foolproof pumping installations that match your exact requirements... call in your Fairbanks-Morse Sales Engineer. Take advantage of his broad technical background and expert knowledge of pumps for air conditioning, plumbing and heating. Call him today, or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY
RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

WHO'S WHAT...

(New personnel, promotions)

▸ *WESTINGHOUSE ELECTRIC CORP.*—Mark W. Cresap, Jr., president and executive officer; Gwilym A. Price, chairman of the board.

▸ *WALWORTH CO.*—John Wallace, president; Harold Brown, vice president and general sales manager.

▸ *CRANE CO.*—Thomas Evans, chairman of the board and chief executive officer; Alfons Landa, Robert B. Crane, and E. A. Locke, Jr., elected to board of directors.

▸ *MANNING, MAXWELL & MOORE*—Charles A. Moore, chairman of the board; Colby M. Chester, treasurer.

▸ *GUSTIN-BACON MFG. CO.*—J. T. Conlon, president.

▸ *ROBERTSHAW-FULTON CONTROLS CO.*—Richard S. Reynolds, Jr., chairman of board of directors.

▸ *PENNSYLVANIA RANGE BOILER CO.*—Harry Lasky, vice president in charge of sales, re-elected chairman of water heater division of *GAS APPLIANCE MANUFACTURERS ASSOCIATION.*

▸ *DODGE MFG. CORP.*—J. Allan MacLean, president; Joseph E. Otis, chairman of board of directors.

▸ *PULLMAN VACUUM CLEANER CORP.*—John M. Colonas, vice president in charge of engineering.

▸ *YORK DIV., BORG-WARNER CORP.*—Richard J. Halloran, general manager of Decatur, Ill., works.

▸ *CHAS. T. MAIN, INC.*—Franklin P. Parker, elected a director of company.

▸ *DIAMOND POWER SPECIALTY CORP.*—William H. Jackson, vice president in charge of sales.

▸ *BABCOCK & WILCOX CO.*—James S. Anderson, vice president in charge of sales for company's tubular products division, appointed general manager of division; Dr. Lauchlin M. Currie, elected to board of directors; Charles T. Smith, assistant marketing manager.

MARSH PACKLESS RADIATOR VALVES

WHEEL HANDLE

GRADUATED

LOCK AND SHIELD

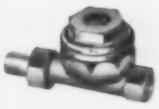
ANGLE PATTERN

GLOBE PATTERN

CORNER PATTERN (Sectional Below)

MARSH THERMOSTATIC RADIATOR TRAPS

ANGLE PATTERN

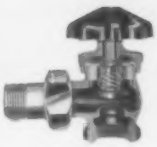


STRAIGHTWAY PATTERN

VERTICAL PATTERN

LEFT HAND CORNER PATTERN

RIGHT HAND CORNER PATTERN



CUT OPEN VALVE

F&T TRAPS

No. 12, REPRESENTATIVE OF WIDE LINE

VENTS

No. 5 VENT, ONE OF MANY

BUCKET TRAPS

No. 500 INVERTED BUCKET TRAP

All the best of their kind!

You probably have made certain Marsh products your standbys without realizing there are a lot more of them just as superlative as the ones you like so well.

Make the acquaintance of some of them here, but, better still—***Ask for this Marsh Catalog!***

MARSH HEATING EQUIPMENT CO.
Sales affiliate of Jas. P. Marsh Corporation
DEPT. T, SKOKIE, ILL.
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd St., Edmonton, Alberta

MARSH
Heating Specialties since 1865

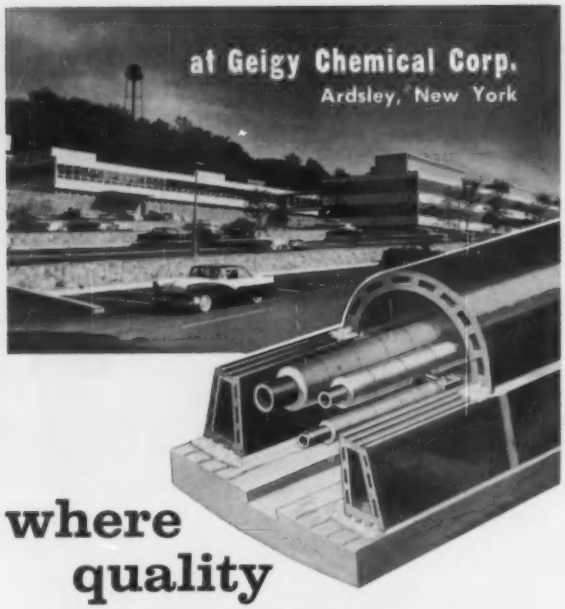
GAUGES AND THERMOMETERS

THER-ALTI-METER (Square and Round)

HOT WATER BOILER THERMOMETER

PIPING THERMOMETER
Four Ranges
(Also remote reading)

DUCT THERMOMETER
Three Ranges
(Also remote reading)



where quality really counts...

Therm-O-Tile IS THE CHOICE

"Quality" isn't just a word, it's a necessity in modern industry. No wonder Guy B. Panero, Consulting Engineer specified Therm-O-Tile conduit for the underground piping here.

★ QUALITY
Therm-O-Tile is manufactured and installed under a continuing quality inspection system assuring the finest possible product.

★ ECONOMY
Therm-O-Tile offers double economy: (1) low initial cost (2) low maintenance cost as piping failures within the conduit can be easily located and repaired.

★ LONG LIFE
A Therm-O-Tile installation will last longer because the vitrified tile with which it is made is one of the most permanent materials known to man.

Get complete details; write today:
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Therm-O-Tile®
CONDUIT FOR UNDERGROUND PIPING

H. W. PORTER CO., INC. — NEWARK 12, NEW JERSEY
or Subsidiary
REID HAYDEN, INC.— BALTIMORE • CHARLOTTE • RICHMOND

WHO'S WHAT

Continued

▸ *WHEELABRATOR CORP.*—Harold F. Schulte, chief engineer.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—J. R. Jamieson, chief field engineer.

▸ *RANSOME TORCH & BURNER CO.*—Chris Gorman, vice president and general manager.

▸ *OLD DOMINION IRON & STEEL CORP., SUBS. of RECONY CORP.*—H. P. Peterson, chief engineer; Karl H. Miller, chief industrial engineer.

▸ *YORK DIV.* of *BORG-WARNER CORP*—Alwin B. Newton, director of engineering, also named vice president.

▸ *CRANE CO.*—William O. Brown, vice president for trade relations; William B. Gilmour, director of marketing; R. A. Pape, assistant to director of marketing; Robert B. Crane, assistant to vice president for marketing and procurement. George W. Dormody, director of procurement; D. R. Nordwall, general manager of sales.

▸ *LANCASTER PUMP & MFG. CO., INC.*—Arno E. Richter, vice president in charge of sales.

▸ *TRENT TUBE CO., SUBS.* of *CRUCIBLE STEEL CO. OF AMERICA*—Lyle E. Baker, assistant general sales manager.

▸ *WHEATLAND TUBE CO.*—Karl F. Lukens, vice president in charge of sales, named chairman of the *AMERICAN IRON AND STEEL INSTITUTE's* committee on steel pipe research.

▸ *RUBEROID CO.*—James P. Carroll, director of public relations.

▸ *KEASBEY & MATTISON CO.*—Daniel P. Maloney, general plant manager in charge of manufacturing operations at company's St. Louis factories; H. J. Angstadt, manager of company's asbestos-cement pipe plant in Santa Clara, Calif.; John L. Rainey, plant manager of Merideth, N. H., textile factory; Albert Allwood, service and development engineer in charge of new product development at Merideth factory; Kenneth M. Eden, general sales manager of company's building products division; Hugh M. Carleton, purchasing agent; James C. Butler, staff chemist in research and development department.

Underground hot pipes stay free from trouble...when you INSULATE WITH GILSULATE

One of the most difficult problems in designing underground hot piping systems is providing positive corrosion protection against electrolytic, chemical or galvanic attack. The answer lies in the use of GILSULATE. For, in addition to its excellent insulating properties, this naturally-occurring hydrocarbon is chemically neutral in all soils, dielectric, and moisture-proof and water-proof as well.

GILSULATE's low thermal conductivity, low cost and easy installation make it possible for schools, colleges, housing projects, hospitals, industrial plants and other institutions to install central heating with underground piping and to realize the savings in equipment and operating costs which such systems provide.

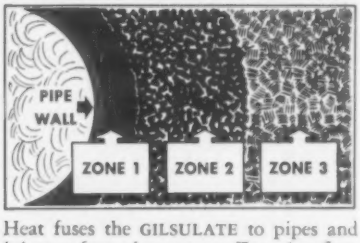
We'll help you with your plans

If you are planning to rehabilitate present piping, or to install a new underground hot piping system, it will pay you to contact your nearest GILSULATE Distributor. His own extensive experience in the field of heating, piping and air conditioning, plus the research, engineering and field supervision facilities of the American Gilsonite Company are at your disposal...without obligation. They will work with your engineers in checking specifications, unusual soil conditions, and actual installation to make sure that the finished job is completely satisfactory.

If you would like complete information on GILSULATE insulation, or would like to be put on the mailing list to regularly receive free copies of PIPE INSULATION NEWS, send your request to any of our offices.

GILSULATE IS EASY AND ECONOMICAL TO USE

GILSULATE completely frees you of the expensive, time-consuming preparation required by many insulating systems. You just pour it into the pipe trench, shovel-point it around the pipes, and tamp it. Pipe heat does the rest.



Heat fuses the GILSULATE to pipes and joints to form three zones: Zone 1, a flexible, heavy-duty water barrier; Zone 2, of firmly-cemented granular GILSULATE that provides excellent thermal insulation under wet or dry conditions; and Zone 3, which provides a final zone of thermal insulation and a support for the water-proof structure.

GILSULATE®
TRIPLE ZONE INSULATION
FOR UNDERGROUND HOT PIPES

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Affiliate of Barber Oil Corp. & Standard Oil Co. of Calif.
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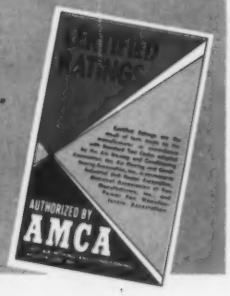
3537 Lee Road, Cleveland 20, Ohio
Distributors in Principal Countries of the World

Type BB Fan

Aladdin
AIR HANDLING EQUIPMENT

For
EFFICIENCY and
QUIET OPERATION...

CERTIFIED
PERFORMANCE



ALADDIN Type BB Fans are the first choice of many engineers for heating, ventilating and air conditioning jobs. Designed for low rotational speeds and high efficiency, these fans insure that stable performance from free delivery to shutoff that engineers have come to expect of this type of equipment.

In designing the BB Fan, Aladdin engineers have refused to short-cut quality, each fan is ruggedly built and is backed by thirty-five years of experience and manufacturing know-how.

Write for complete data

A1

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

WHO'S WHAT

Continued

▸ *SKAGGS-WALSH, INC.*—Fred W. Heaney, president, elected president of *OIL HEAT INSTITUTE OF AMERICA, INC.*

▸ *MT. HAWLEY MFG. CO.*—Andrew L. Schuyler, national sales manager.

▸ *AIR POLLUTION CONTROL ASSOCIATION*—Arnold Arch, executive secretary.

▸ *WALWORTH CO.*—Robert L. White, advertising manager.

▸ *RAYPAK CO., INC.*—Richard M. Norton, special assistant to general sales manager.

▸ *JOSEPH T. RYERSON & SONS, INC.*—Clive C. Earle, sales manager; Robert H. Marta, manager of general order department.

▸ *STONE & WEBSTER ENGINEERING CORP.*—M. H. Cutler, engineering manager; Thomas A. Fearnside, assistant engineering manager; Floyd F. Dedrick, chief mechanical engineer.

▸ *ALLIS-CHALMERS MFG. CO.*—Homer P. Binder, consultant, and Hugh L. Ross, manager of company's pump department.

▸ *DIXIE BRONZE CO.*—L. H. Durdin, president, president of *AMERICAN FOUNDRYMEN'S SOCIETY.*

▸ *ARCOS CORP.*—Walter H. Wooding, recently appointed to research and engineering department.

▸ *YOUNGSTOWN SHEET AND TUBE CO.*—John Wampler, manager, and Ralph Marsh, assistant manager of pricing department.

▸ *TRANE CO.*—Wesley W. Wright, assistant manager of "CenTraVac" sales department.

▸ *WM. STEINEN MFG. CO.*—Vernon M. Griebel, account executive for heating products division.

▸ *DUST SUPPRESSION AND ENGINEERING CO.*—Quentin Keeny, sales manager.

▸ *WHITE-RODGERS CO.*—Robert N. Weber, manager of new product planning division; John H. Martin, manager of new marketing and research division.

Marlo HEATING AND COOLING COILS USED IN LUXURY LINER'S MAMMOTH AIR CONDITIONING SYSTEM

From wintry shores of the North Atlantic to sun-drenched isles of the tropics, vacationers aboard Grace Line's new $25 million luxury liner *Santa Rosa* enjoy perfect comfort all the way. Sailing from New York every two weeks for cruises to the Caribbean area, the *Santa Rosa* provides its 300 passengers with every facility for pleasure and relaxation.

The huge air conditioning system on the 583-foot ship incorporates Marlo heating and cooling coils in a wide range of sizes, delivers comforting warmth in northern latitudes and refreshing cooling in tropical and semi-tropical regions.

Owned by the Grace Line, Inc., the *Santa Rosa* was designed by naval architects Gibbs & Cox, Inc., and built by Newport News Shipbuilding and Dry Dock Company. Interior architects were Eggers & Higgins, Inc., and decorators were Smyth, Urquhart & Marckwald.

Marlo offers a complete line of equipment for every air conditioning and heat transfer need. Consult the Marlo representative in your area, or write direct to us for further information.

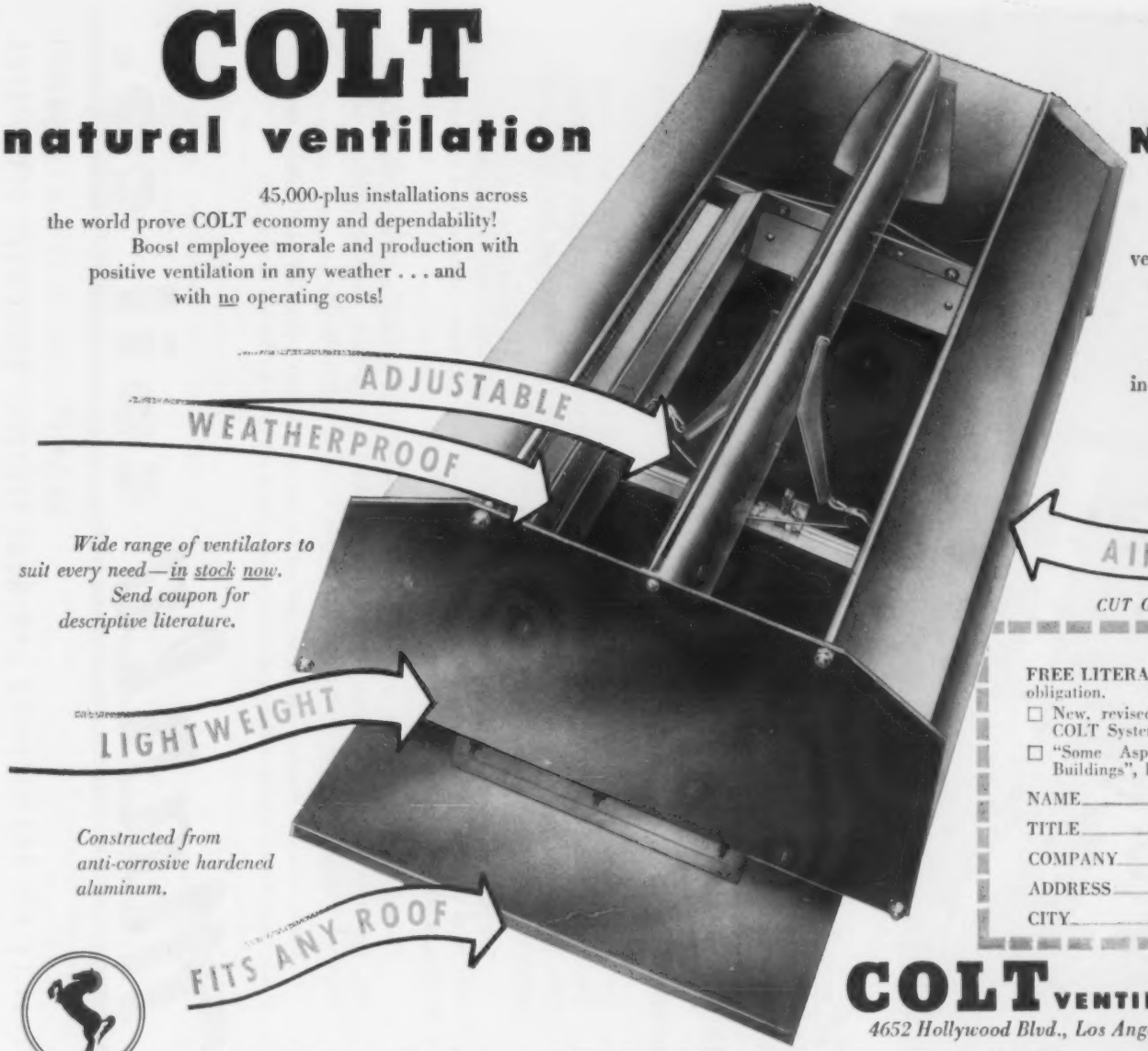
Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

COLT
natural ventilation

45,000-plus installations across the world prove COLT economy and dependability! Boost employee morale and production with positive ventilation in any weather . . . and with no operating costs!



Wide range of ventilators to suit every need—in stock now. Send coupon for descriptive literature.

Constructed from anti-corrosive hardened aluminum.

NEW COLT "O/SR"
RESERVE-CAPACITY VENTILATOR

This new, extra high performance ventilator was developed by COLT to meet the problem of venting occasionally excessive heat and fumes. The airfoil adjustable center provides a large clear opening which creates lift to increase extraction velocity. Rainproof flaps may be set for normal conditions, opened wide to exhaust extreme heat, or closed to retain heat on cold days.

AIRFOIL DESIGN

CUT OUT COUPON AND MAIL TODAY

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FREE LITERATURE. Please send items checked, without obligation.

- ☐ New, revised TECHNICAL MANUAL describing the COLT System.
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Southern California Distributor • **RELIABLE STEEL SUPPLY CO.,** *740 East 111th Place, Los Angeles 59, California • PLymouth 6-8111*

WHO'S WHAT

Continued

▸ *YOUNGSTOWN SHEET AND TUBE CO.*—Robert C. Bryan, recently joined staff of comptroller.

▸ *REFRIGERATION SALES CORP.*—Fred F. Olland, manager of contract division.

▸ *EMBASSY STEEL PRODUCTS*—C. Russell Schluter, district sales manager.

▸ *FLEXIBLE TUBING CORP.*—Robert H. Stevenson, Jr., manager, air conditioning sales.

▸ *TYPHOON AIR CONDITIONING CO., DIV. of HUPP CORP.*—Norman Reitman, advertising and sales promotion manager.

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *DRAYER-HANSON, DIV. of NATIONAL-U. S. RADIATOR CORP.*—General Equipment Co., Spokane, Wash., sales representative.

▸ *BALTIMORE AIRCOIL CO., INC.*—Roger G. Anderson of the F. W. Jenike Co., Cincinnati, representative in southwest Ohio and areas of Kentucky and Indiana; J. P. Ashcraft Co., Inc., Oklahoma City, representative throughout state of Oklahoma; Richardson Equipment Co., Boise, Idaho, representative for southern and central Idaho.

▸ *TORIT MFG. CO.*—Richard Bennett, regional sales manager for the Chicago area.

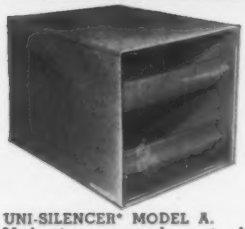
▸ *BOHN ALUMINUM & BRASS CORP.*—William A. Jaynes, sales representative assigned to company's Detroit sales office.

▸ *L. J. WING MFG. CO.*—R. J. McCrory, Jr., Pittsburgh area representative.

▸ *WOLVERINE TUBE, DIV. of CALUMET & HECLA, INC.*—Robert W. McKenzie, sales representative in Birmingham, Ala., with a territory including parts of Alabama, southern Mississippi, and northwest Florida.

▸ *AUTOCON INDUSTRIES, INC.*—Gayle D. Testin, western divisional sales manager; William W. McGuire, eastern divisional sales manager.

UNI-SILENCER* For AIR CONDITIONING and VENTILATING SYSTEMS



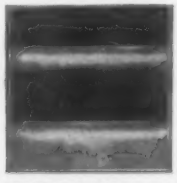
UNI-SILENCER* MODEL A. Moderate pressure drop, standard acoustical efficiency

UNI-SILENCER* MODEL LPD. Lowest possible pressure drop, moderate acoustical efficiency

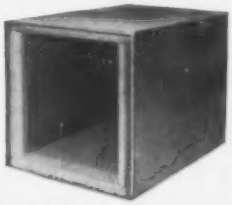
A full line of Elof Hansson silencers to effectively reduce airborne noise generated by fans in air conditioning, ventilating systems and by power roof ventilators. They are easily and conveniently installed in building structures at low cost due to new mass-production methods made possible by standardizing on modular sizes. Savings are of such proportions that UNI-SILENCER* prices compare favorably with conventional duct lining.

The performance of UNI-SILENCERS*, both as to acoustical attenuation and pressure loss have been tested and certified by independent, impartial outstanding authority. The certified data is guaranteed in writing and bonded. Free engineering service!

Fill out and mail coupon for literature today!

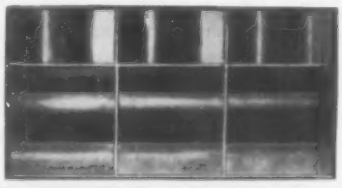


UNI-SILENCER* MODEL B. Higher pressure drop, maximum acoustical efficiency



UNI-RESONATOR* — Low frequency duct silencer — used in series with UNI-SILENCERS*.

UNI-SILENCERS* are slip-joined in simple manner as with children's building blocks, to fit almost any conditions or requirements.



T. O. SILENCER Elbow silencer for ducts

E H ROOF VENTILATOR SILENCER for power roof ventilators

FREE! . . . and available to distributors for the first time —UNI-SILENCER SELECTION CHART © E. H. INC., with tested Data and Directions.

*Reg U.S. Pat. Off.

ELOF HANSSON, INC. *Acoustical Division*

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ELOF HANSSON, INC., Acoustical Division
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Please send literature on performance-guaranteed UNI-SILENCERS, UNI-RESONATORS and the new UNI-SILENCER SELECTION CHART.

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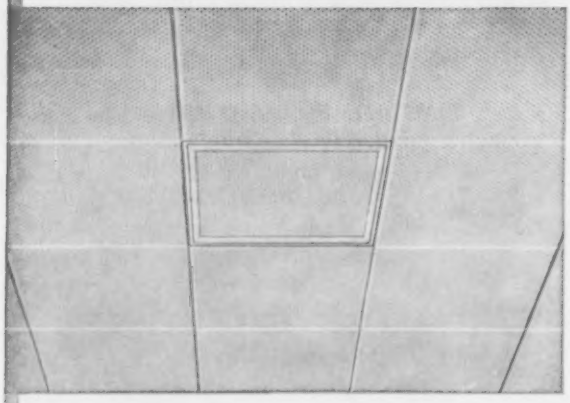
AGITAIR® Perfair

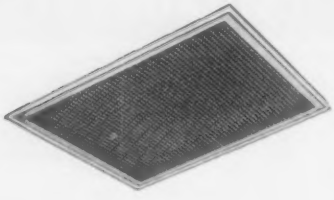
PERFORATED AIR OUTLETS

ADJUSTABLE — NON-ADJUSTABLE
SQUARE AND RECTANGULAR

the Ultimate in Application Versatility



AGITAIR PERFAIR diffusers provide the architect with a concealed air outlet that blends in perfectly with acoustical ceilings rather than calling attention to the mechanical installation. To complete the cycle of air distribution and conform with the architectural design, PERFAIR diffusers are also available as return or exhaust units in matching designs.



PERFAIR diffusers incorporate smartly designed mounting frames and exclusive AGITAIR removable diffuser cores which provide unmatched blow patterns in 1-2-3-4 way blows. The inner cores have an added feature... built-in direction controllers that provide deflection of the air stream from one or more sides individually in varying degrees from horizontal to downward delivery of air.

AGITAIR PERFAIR air diffusers are available for surface or tile mounting that will not only blend in with the ceiling design but will distribute the air noiselessly and draftlessly. AGITAIR PERFAIR is another genuine product designed for Better Air.

Send for complete Perfair Catalog

AIR DEVICES INC.
185 MADISON AVENUE • NEW YORK 16, N. Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

WHO'S WHAT

Continued

▸ *DODGE MFG. CORP.*—Paul Keb and Jack Stroobandt, sales representatives in Charlotte, N. C.; Charles Curtis, parts sales representative in Connecticut, Massachusetts, and New York.

▸ *GUSTIN-BACON MFG. CO.*—Culberg Asbestos, Chicago, contracting distributor for company's glass fiber insulations.

▸ *ACME INDUSTRIES, INC.*—Olan J. Hill, sales engineer in Kentucky.

▸ *CYCLOTHERM DIV., NATIONAL-U. S. RADIATOR CORP.*—L. J. Prues and associates, San Francisco, distributor for northern California.

▸ *CARLON PRODUCTS CORP.*—Thomas W. Kreiner, southwest regional sales manager.

▸ *H. C. LITTLE BURNER CO., INC.*—Ludwig Otonicar, factory representative in Ohio, West Virginia and Michigan.

▸ *AMERICAN-STANDARD, PLUMBING AND HEATING DIV.*—John W. Wallace, Jr., sales manager for Cleveland sales office; Frank Macielag, sales manager of Salt Lake City sales office.

▸ *TORRINGTON MFG. CO.*—Frank Zega, field sales engineer in Kentucky and western Tennessee for the *AIR IMPELLER DIV.*

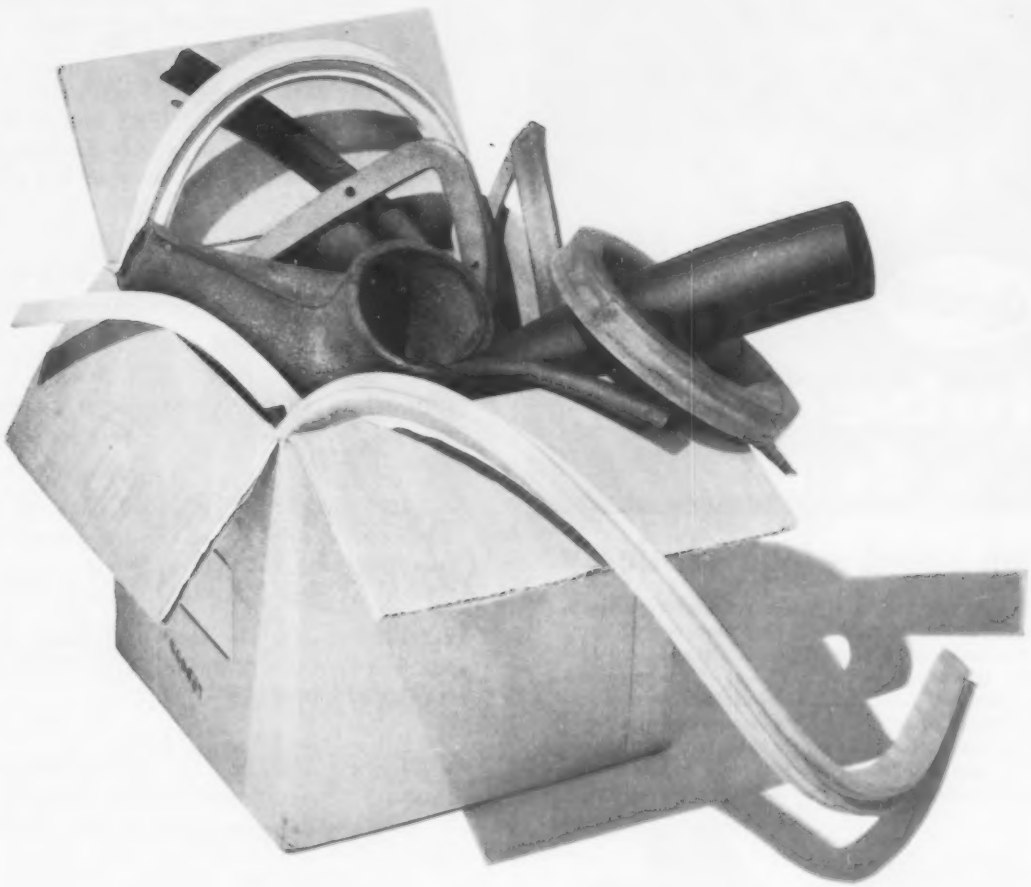
▸ *WARREN PUMPS, INC.*—Edward H. Elliott, industrial sales representative in Baltimore area, with a sales area including Maryland, northern Virginia, and eastern West Virginia.

▸ *EMBASSY STEEL PRODUCTS, INC.*—J. Doug Toole & Co., representative in southwest and Rocky Mountain area.

▸ *HARCRAFT BRASS*—Edward Kretske, Kretco Sales, Chicago, sales representative for northern Illinois and counties in northern Indiana; E. B. Rouzer Co., Inc., Minneapolis, sales agent for Minnesota, North and South Dakota and northwestern Wisconsin.

▸ *CENTURY ELECTRIC CO.*—New location of Chicago district office: 6835 W. Higgins Rd., Chicago 31, W. D. Helm, district manager.

B.F.Goodrich



If it sweats, rattles, shakes or leaks . . .

. . . it shouldn't! And if you ask B.F.Goodrich, it won't! B.F.Goodrich, as the largest producer of sponge rubber and cellular plastic, makes special or standard parts for the refrigeration and air conditioning industry. Typical functions of these parts are sealing, gasketing, insulating and vibration damping – under the most trying conditions.

So get the advantage of the experience that has put B.F.Goodrich cellular materials into The Sheraton Hotel, Philadelphia; The Conrad Hilton, Chicago; The Corning Glass Building, New York and many other New York office buildings. Write The B.F.Goodrich Company, 581 Derby Place, Shelton, Connecticut.

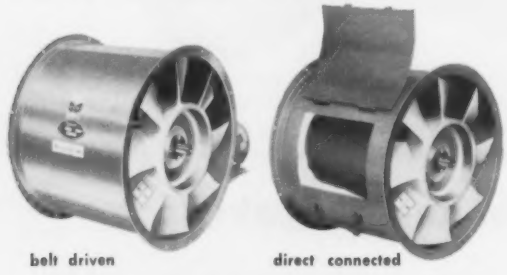
B.F.Goodrich ***industrial cellular materials***

NEW 8 blade

tubeaxial fans

high speed - high efficiency

Aerovent's new Tubeaxial Fan, designed around a new 8-blade "Macheta" Airfoil Axial Flow Propeller, offers top performance against medium pressures at speeds to 3450 RPM. Available in 16", 18", 24", and 30" diameters, this unit combines speed, stamina and modern functional design. Easily installed in present ductwork or engineered to new construction, it's the right answer for resistances to 4" SP. Another outstanding development from Aerovent—America's finest industrial fans and air equipment.



belt driven direct connected

WRITE FOR FREE BULLETIN 350

Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

CERTIFIED PERFORMANCE

Aerovent FANS

Aerovent

FAN COMPANY, INC.

ASH and BRANCH STS. PIQUA, OHIO

WHO'S WHAT

Continued

▸ *INDUSTRIAL ACOUSTICS CO., INC.*—Daniel B. Callaway, in charge of company's new west coast office at 1532 Third St., Santa Monica, Calif.

▸ *NATIONAL SUPPLY CO., TUBULAR DIV.*—Frank Kerr, sales representative in Philadelphia; A. Neal McCasdey, sales representative in Kansas City, Mo.; William E. Bunnell, sales representative in Tucson, Ariz.

▸ *CONTROLS CO. OF AMERICA*—Pioneer Electronic Supply Co., Cleveland, and Southern Wholesalers, Inc., Dalton, Ga., distributors in their respective areas.

▸ *SOLAR AIRCRAFT CO.*—Herbert H. Bowie, manager of Army relations in the company's southeastern district sales office.

▸ *DURO-DYNE CORP.*—William D. Bogh, sales representative for southern California and Arizona.

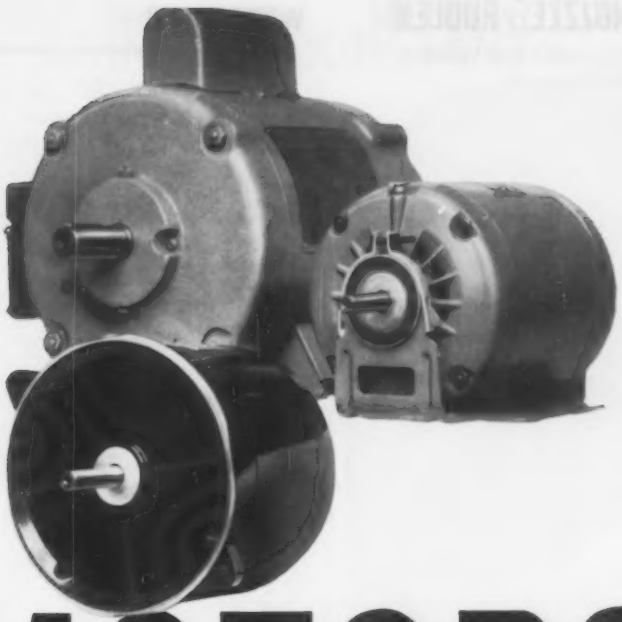
▸ *LADISH CO.*—W. F. Brockwell and R. O. Barlen, sales representatives in the new Dallas area sales office: Room 1010, 211 N. Ervay Bldg.

▸ *CONTROLS CO. OF AMERICA*—Fisher Switches, Inc., San Francisco, distributor; E. E. Taylor, Albany, N. Y., distributor.

▸ *WILLIAM WALLACE CO., METALBESTOS DIV.* Harold E. Sweatt, eastern district manager; Allen A. Putt, special representative for the company with headquarters in Washington, D. C.

▸ *BINKS MFG. CO.*—Robert Hamlin, representative in Cleveland area; J. Coughlin, representative in Columbus, Ohio, region; Ed Gogin, field representative in San Francisco branch; Robert E. Moser, sales representative in Virginia territory; Dan E. Power, Jr., and William B. Crawford, field representatives in Atlanta branch; A. Glines, and A. McMillan, New England territory representatives.

▸ *FARR CO.*—New sales representatives include: McMurry and Co., Miami, Fla.; F. C. Clifford Inc., Baltimore; George A. Schiller, Rochester, N. Y.; Law Instrument Co., Angola, Ind.; Air Filter Sales & Service, Portland, Ore.; General Equipment Co., Spokane, Wash.; Engineering Sales Co., New Orleans, Jackson, Miss., Baton Rouge, La., and Mobile, Ala.



MOTORS

performance-proved by industry's leaders

for

OIL BURNERS
BLOWERS
PUMPS
COMPRESSORS
UNIT HEATERS
AIR CONDITIONERS
COOLING TOWERS
VENTILATORS

Leading names in our nation's industries use Marathon Electric Motors to produce quality products. A wide range of standard Fractional and Integral HP Motors are available, as well as engineering services to tailor make motors to your requirements.
Send today for Bulletins SB-179 and SB-180.

MOTORS AND GENERATORS—THAT'S OUR BUSINESS

Motors from 1/20 to 3500 H.P. Generators from 1/2 KW to 2500 KW

MARATHON ELECTRIC

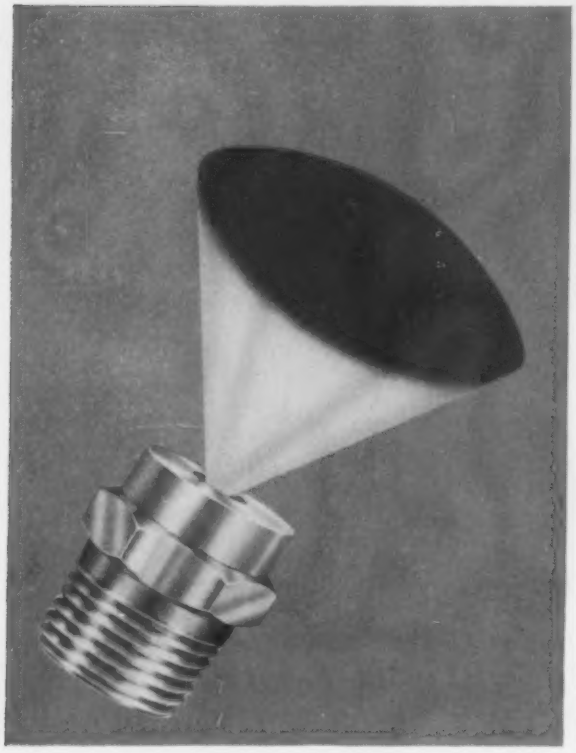
Home Office and Factory, Wausau, Wis. • Factories at Erie, Pa., and Earlville, Ill. • Sales Offices in Principal Cities

AIR CONDITIONING NOZZLE PROBLEM

To select a nozzle which will provide efficient water coverage to condensing coils

SOLUTION

Delavan Type SC nozzle



The extremely solid cone pattern delivered by the SC nozzle assures maximum heat transfer and minimum corrosion build-up on condensers. The SC provides excellent performance at low pressures. It is furnished with a hex body for easy installation and is available in a wide range of capacities, spray angles, pipe sizes and materials.

Whatever nozzles you require for air conditioning applications, there's a Delavan that does the job best. Write today for Catalog 33A.

DELAVAN *Manufacturing Company*

WEST DES MOINES, IOWA

WORLD'S LARGEST NOZZLE SPECIALIST

WHO'S WHAT

Continued

▸ *OPW CORP., DIV.* of *JORDAN CORP.*—Charles A. Ault, III, northwestern district manager, with offices in Seattle.

▸ *PARKER-HANNIFIN CORP.*—Al Xander Co., Corry, Pa., authorized distributor.

▸ *A. M. BYERS CO.*—Aetna Engineering Co., Alton, N. H., distributor for company's wrought iron pipe.

▸ *CLEAVER-BROOKS CO.*—Dyke and Tutsch Co., Milwaukee boiler sales representative for packaged fire tube boilers in entire state of Wisconsin.

▸ *KEASBEY & MATTISON CO.*—William H. Mashburn, Houston district manager.

▸ *PHILIP CAREY MFG. CO.*—New sales representatives on company's national accounts staff include: Frank M. Boylan, metropolitan New York-Boston area; Robert L. Smith, Chicago, St. Louis, Detroit and Milwaukee areas; George C. Cheap, California and Arizona Areas.

▸ *DRAVO CORP.*—James E. Shafer, Jr., manager of new sales office in Hartford, Conn., located at 119 Ann St.

▸ *E. I. du PONT de NEMOURS & CO.*—Kenneth E. Dallas and Donald L. Kjelleren, technical sales representatives for the Syracuse, N. Y. and New York-New England territories, respectively.

▸ *AMERIVENT DIV., AMERICAN METAL PRODUCTS CO., INC.*—Myron L. Unversaw, eastern sales manager with headquarters in Indianapolis.

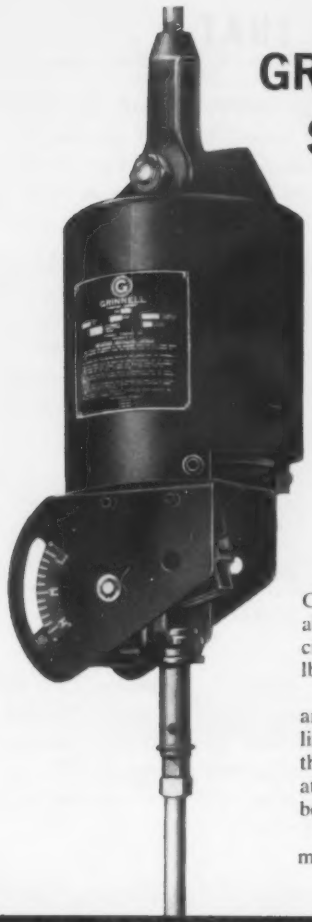
▸ *W-K-M, DIV.* of *ACF INDUSTRIES, INC.*—Fritz O. Befeld, sales representative in southeastern U. S.

▸ *SPENCER DIV., METAL & CONTROLS CORP.*—Robert G. Metzger, field engineer in western Michigan.

▸ *J. E. LONGERGAN CO.*—John J. Soukup, sales engineer, Philadelphia area; R. C. Bechert Co., New York representative; Agren-Ascher Co., Detroit representative.

▸ *LIMA REGISTER CO.*—Bryant-Hedback Co., Indianapolis area distributor. ≠

GRINNELL CONSTANT SUPPORTS...



2 BASIC DESIGNS...
11 DIFFERENT METHODS OF ATTACHMENT

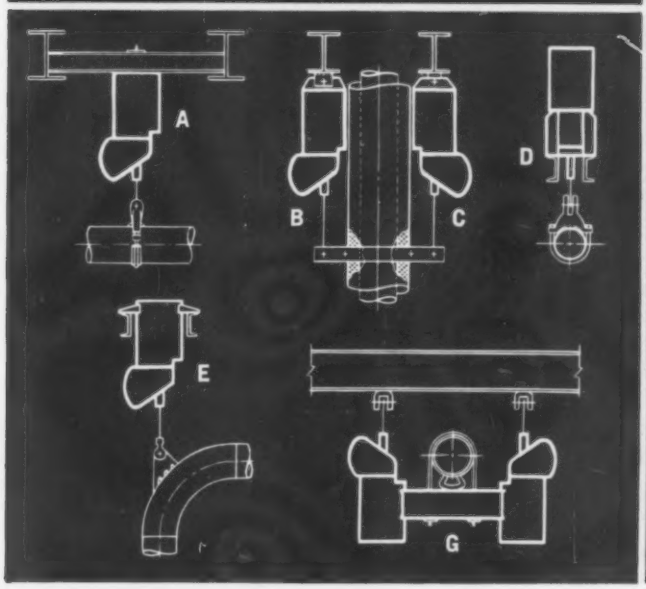
Grinnell Constant Supports are available in a range of sizes to provide capacities for loads from 27 lbs. to 57,500 lbs., with travels up to 16 inches.

Both vertical and horizontal hangers are designed to operate in extremely limited space. In the selection of types, there is a choice of 11 methods of attachment to structures—either above, between, or below supporting steel.

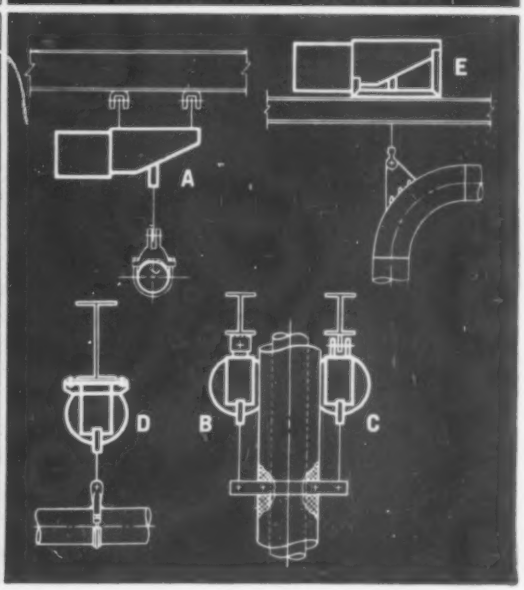
Grinnell Constant Supports provide mathematically perfect load support throughout all positions of travel . . . also a full 70 percentage points of adjustability is built into them. No less than 10% of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt.

Call on Grinnell's Pipe Suspension Department for help with your pipe suspension problems. Grinnell Company, Providence 1, Rhode Island.

FOR VERTICAL ATTACHMENT



FOR HORIZONTAL ATTACHMENT



GRINNELL

AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Quickdraft... THE WORLD'S SAFEST

POWER DRAFT UNIT FOR INDUSTRIAL, RESIDENTIAL AND INSTITUTIONAL EXHAUSTING

Increases heating and combustion efficiency!

Provides air power for bulk materials handling!

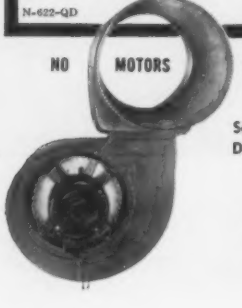
Exhausts corrosive gases and abrasives!

Quickdraft provides industry, commerce, institutions and homebuilders *power draft* engineered for economical and efficient combustion regardless of building or atmospheric conditions. Models suitable for every heating or incinerator application . . . eliminate pulsating or chattering, puffing, smoking and sooting. Reduce building costs, no tall, unsightly stacks required. Quickdraft also provides industry with ¼ inch to 60 inches W.G. static pressure for exhausting corrosive gases, abrasives and paint spray. Heavy-duty, high-pressure models, 6 inches to 30 inches diameter, are available for moving bulk materials or anything that can be moved by air. Because there are no motors, fans or bearings in exhaust line, only Quickdraft avoids costly clogging, corrosion of moving parts or fan failure.

IMPORTANT NOTICE

For withstanding corrosive gases, all Quickdraft units are available in standard acid resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P.V.C.) and with plastic and Fiberglas coatings.

N-622-QD



NO MOTORS FANS OR BEARINGS IN EXHAUST LINE

Send for QUICKDRAFT ENGINEERING DATA on your application . . . now.

Quickdraft CORPORATION

P.O. Box 87-K, Canton 1, Ohio

WE HEAR THAT . . .

▸ The national *BETTER-HEATING-COOLING COUNCIL* recently moved to larger quarters at 250 Park Ave., New York, at the same address the organization has maintained since its founding in 1956.

▸ *PENNSALT CHEMICALS CORP.* launched a nationwide merchandising campaign for air conditioning and refrigeration wholesalers and servicemen with the announcement of its free cylinder stand promotion. Cards explaining how the newly designed cylinder stand could be obtained free were sent to 15,000 refrigeration and air conditioning servicemen.

▸ The Cavalcade of Products of *YORK DIV.* of *BORG-WARNER CORP.* made its last stop at the division's home town in York, Pa. The exhibit has been displayed in 17 cities in an 82 day coast-to-coast tour that covered nearly 15,000 miles.

▸ A new firm of consulting engineers, *IAN GRAD ASSOCIATES*, has opened offices at 114 E. 32nd St., New York 16. The new firm will offer mechanical, electrical and industrial engineering services to the architectural profession, and the construction and manufacturing industries.

▸ *SIGNET CONTROLS* is the name of a new Portland, Ore., organization in the automatic controls field which will manufacture a line of products for the heating and air conditioning industries. It is an outgrowth of the heating controls department of *IRON FIREMAN MFG. CO.'s* electronics division.

▸ *ARKLA AIR CONDITIONING CORP.*, a wholly owned subsidiary of *ARKANSAS LOUISANA GAS CO.* will begin construction of a new $2 million factory this summer at Russellville, Ark. The new 45,000 sq ft plant will produce natural gas meters, industrial control devices, and a variety of gas burning appliances.

▸ On the occasion of his retirement from the company *ARTHUR C. LESHER* received *KEASBEY & MATTISON CO.'s* "Elder Statesman" award. The citation was presented to the retiring purchasing agent in honor of his 53 years of service with the company.

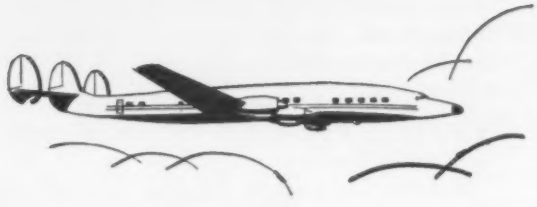
▸ *OHIO BRASS CO.* and its wholly owned subsidiary, *HOLAN CORP.*, have announced the purchase of *UNIVERSAL HYDRAULICS, INC.* The recently purchased firm will operate as a subsidiary of *HOLAN CORP.* and will make hydraulic cylinders and valves.

B-1 Flux is particularly effective in removing refractory oxides such as those formed in stainless steels.

Operator fits preformed ring of BRAZE 541 prior to fluxing. This is a hose and tube assembly for an oil line.

Here operator applies gas-air torch, hand-feeding BRAZE 541 to joint.

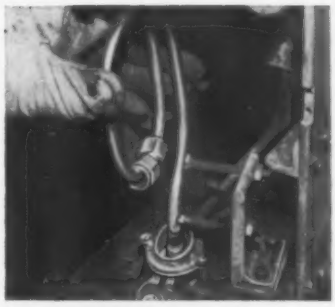
Oil-bearing unit under induction heating.



Here's How Stainless Steel Fuel Systems Benefit From

HANDY & HARMAN SILVER BRAZING

Tube Processing Corporation, Indianapolis, Indiana, makes aircraft and missile fuel systems and, if anything has to be more failure-proof than a fuel line assembly in an airplane, you name it. The units shown here are made of 410 stainless steel tube and 321 stainless steel fittings; when they're joined, they must be joined permanently. Exhaustive tests, including X-ray, pass on each assembly before final acceptance.



Operator placing oil line (of another type) in induction heating ring.

To meet all requirements: strength, ductility, liquid and airtightness, production speed and economy, Tube Processing uses Handy & Harman's special alloy BRAZE 541 (formerly Alloy 4772) and HANDY B-1 FLUX.

Developed strictly for brazing stainless, BRAZE 541 is one of many Handy & Harman brazing alloys—both standard and special—made to do a specific job and do it better than any other metal-joining method.

Name your product and the metals it's made of, the chances are very good indeed that one of Handy & Harman's silver brazing alloys can join it better than the method you now employ. Better from every aspect: economy, speed, strength, conductivity, labor savings. Put your product in these pictures for the same benefits.

An exclusive additional benefit is Handy & Harman's application Engineering Service. This is a service that exists to show you how these benefits can best be applied to your product. We invite you to take advantage of both Handy & Harman Brazing Alloys and Engineering Service.

GET THE FACTS

Technical Bulletins T-1 and T-2 give the general characteristics of silver brazing alloys plus the compositions, melt and flow points of 32 separate alloys. Write for your copies.

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

OFFICES AND PLANTS
ATLANTA, GA.
BRIDGEPORT, CONN.
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TORONTO, CANADA
MONTREAL, CANADA

IN MODERNIZATION

GRACIOUS LIVING CALLS FOR

THERMAL

When the Plaza Hotel in Houston planned to modernize its air conditioning system, Thermal multi-zone units were chosen to assure the year-around comfort of the Hotel's transient and permanent guests.

The Thermal line of quality equipment is famous for long life and efficient operation—which means it can be specified with confidence to deliver years of satisfaction. Thermal Engineering equipment includes central plant air conditioners, multi-zone air conditioners, cooling and heating coils, sprayed coil units, heating and ventilating units and air cooled condensers.

Detailed catalog available.

H. E. Bovay, Jr.	Consulting Engineers
Baxter Const. Co.	General Contractors
Massey-Graves Co.	Mech. Contr.
McMillan Equipment Co.	Thermal Sales Rep.

Agents in principal cities.

Quality Products Since 1945.

THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

WE HEAR THAT

Continued

Immediate plans call for the expansion of its product line and production facilities.

▸ When *ACME STEEL CO.'s* new steel plant is completed as part of its modernization and expansion program, the company will have a steel-making capacity of over 1 million tons annually.

▸ A two week course conducted by *ARMSTRONG CORK CO.* was attended by 24 of the company's executives. The course was designed to instill a broader understanding of changing management functions in industry.

▸ A course to train and improve the performance of fire inspectors with regard to commercial-industrial oil burner installations has been established by *OIL HEAT INSTITUTE OF AMERICA* at the Springfield Trade School, Springfield, Mass. The new program has 34 men enrolled in two classes.

▸ *WARREN WEBSTER & CO.* has announced its long-range, three year program for research and development. The program has been launched with a view toward incorporating design change wherever it is indicated by market and consumer need. Special emphasis will be placed on research in the air conditioning field.

▸ *ILG ELECTRIC VENTILATING CO.* recently purchased *GENERAL BLOWER CO.* The newly acquired company will operate as *GENERAL BLOWER DIV.* of *ILG ELECTRIC VENTILATING CO.* and will continue to operate with no change in personnel.

▸ *AIR REDUCTION SALES CO., DIV.*, of *AIR REDUCTION CO., INC.* recently completed a new oxygen and nitrogen plant at Denver. The new facility is said to be the first gas-producing installation in the area.

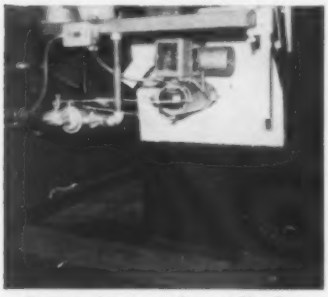
▸ Because of interest shown in its new positive displacement rubber-to-metal pump, the newly formed company, *GOODYEAR PUMPS, INC.*, is setting up a selling organization to cover all parts of the company. Main distributors of pumps are invited to apply for appointment.

▸ Construction has begun on a new addition to the manufacturing plant of the *KENCO PUMP DIV.* of *AMERICAN CRUCIBLE PRODUCTS CO.* in Lorain, Ohio. The one story addition will provide 2160 sq ft

In Barrow, Alaska
U. S. Weather Bureau Selects

LO-BLAST ECONOMITE
POWER GAS CONVERSION BURNERS

Natural gas line must be carried on barrels on the surface, because of the nature of the terrain.



Economite not only supplies heat for comfort but for cooking as well, as on this converted range in hospital kitchen.

'Way up inside the Arctic Circle, where the 49th State pokes a frigid finger into the Beaufort Sea, U. S. Weather Bureau men selected Lo-BLAST Power Gas Burners to insure their own comfort. Thirteen Economites and seven Dual Fuel Lo-BLAST Burners burn natural gas with trouble-free dependability to heat personnel housing, offices, warehouses, hospital, school and other station buildings.

For government or private citizen, Economite adds a bonus of *savings* over and above its dependability—averages 10% lower operating cost. Controlling primary and secondary air perfectly, it functions independently of variable natural drafts—is especially well-suited for down-draft boilers. Combustion is completed in an incandescent firebox, with radiant heat applied to crown sheet and side walls. Other features: soft, quiet flame... standard controls with positive acting pilot and blower safetys...sturdy, fool-proof design...easy to install because completely assembled and factory-tested on gas.

Lo-BLAST Power Gas Burners are available in 70,000 to 20,000,000 B.T.U. input capacities. Write for literature.

Drip valves for condensation are installed at regular intervals.

Main line pressure (80 p.s.i.) is reduced in this station to 15 p.s.i.

Feeder line crossing Nerrovik lagoon is cable suspended.

(Use of this product by a U.S. Government Bureau in no way constitutes an endorsement of the product by the Government)

MID-CONTINENT METAL PRODUCTS COMPANY

1960 Clybourn Ave., Chicago 14, Ill.

Western Rotary® Roof Ventilators

with Lifetime Guaranteed Bearings

- "Backward curved blower wheel" type mechanism assures high, constant exhaust capacity, no backdraft ever.
- Certified wind tunnel tests by non-commercial national institute.
- Unique factory lubricated sealed bearings are specially designed for positioning load, countering wind pressure, assuring stability.
- Lock-on rotor, yet removable without special tools.
- Exclusive Western corrugated vane increases rigidity.
- Low, functional type adds beauty.
- Baked enamel paint coating for beauty and long life.
- Aluminum, copper, or stainless steel construction available.

Other type ventilators include:

- Stationary
- Directional
- Continuous ridge
- Vertical exhaust
- Axial roof
- Unit ventilators

Immediate Delivery on all sizes

Complete Catalog in Sweets and Western States A-E-C

Write for catalog and name of nearest representative.

WESTERN ENGINEERING & Mfg. Co.

4108 Glencoe Avenue, Venice, California

Since 1921 . . . a reliable leader.

WE HEAR THAT

Continued

of manufacturing space. The company's *FOUNDRY DIV.* is also adding 2800 sq ft in an expansion of its centrifugal casting department.

▸ *DRAVO CORP.* has announced a national leasing plan for its line of industrial and commercial space heaters and other equipment. The plan makes it possible for business firms to acquire equipment for base lease periods ranging from 3 to 7 years.

▸ Service personnel from 50 heating and air conditioning companies attended the second annual Automatic Controls Training School, sponsored by *GEORGE T. HALL CO.*

▸ A modern research and test laboratory has recently been designed and installed by *THERM-AIR MFG. CO.* The laboratory was built primarily for the certification of capacity ratings of packaged air conditioners under the *AIR CONDITIONING AND REFRIGERATION INSTITUTE*'s unitary air conditioner program.

▸ *K. B. THORNDIKE*, vice president and eastern regional manager for *DETROIT CONTROLS DIV.* of *AMERICAN-STANDARD*, announced his retirement after 35 years at a recent national sales meeting held by the division.

▸ A new 25 minute 16 mm colored film, entitled, "Muscles of Control," has just been completed by *FISHER GOVERNOR CO.* The film shows how control valves function and how they are engineered.

▸ *REYNOLDS METALS CO.'s* aluminum has been added to the steel stocks of the *JOSEPH T. RYERSON & SON, INC.* Los Angeles warehouse.

▸ The board of directors of *ACME INDUSTRIES, INC.*, has authorized construction of an additional 40,000 sq ft of manufacturing space. The expansion is part of a program which began over two years ago, and will bring the corporation's total manufacturing space to 160,000 sq ft.

▸ The new headquarters of *J. O. ROSS ENGINEERING DIV.* of *MIDLAND-ROSS CORP.* is located at 730 Third Ave., New York 17. The division's new offices occupy the entire ninth floor of the General Telephone Building, and provide 5000 sq ft more floor space than its former quarters.

NOW... for underground fuel oil storage tanks — a tank suction heater with easily accessible service connections

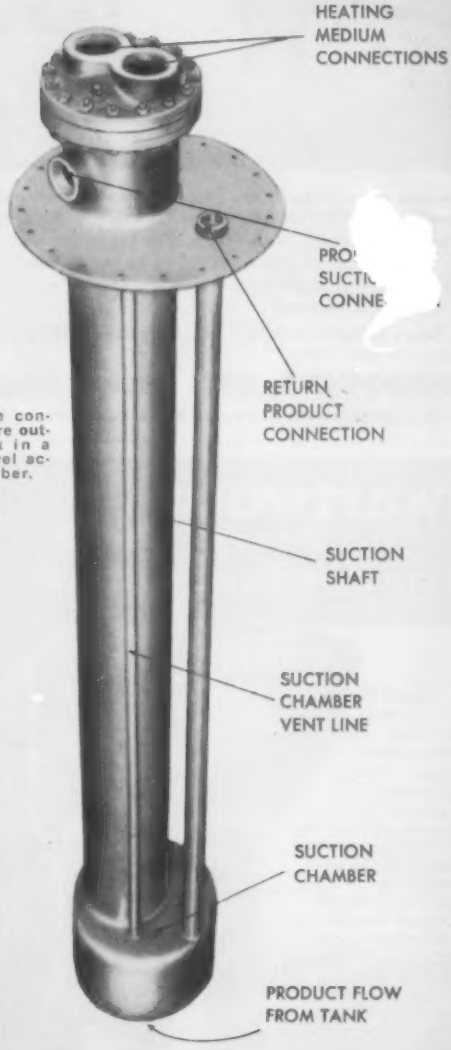
PARACOIL "VUF"

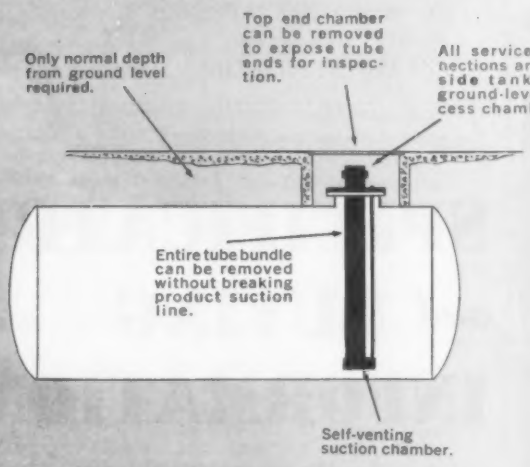
VERTICAL TANK SUCTION HEATER

Designed to simplify both installation and service. Heater is suspended from tank manhole flange. **All connections are outside the tank.**

Uses hot circulated fluids as heating mediums — insuring positive suction temperatures.

The simplest method of preheating fuel oils and other viscous liquids in underground storage tanks.




Only normal depth from ground level required.
Top end chamber can be removed to expose tube ends for inspection.
All service connections are outside tank in a ground-level access chamber.
Entire tube bundle can be removed without breaking product suction line.
Self-venting suction chamber.

Hot return product mixes with fresh product in suction chamber, providing an initial temperature rise even before the heating tubes are reached.

Available in standard sizes and capacities for various product fluids.

Alternate Model (Type VSS) employs high pressure steam as the heating medium.

Write for Bulletin 60-J1

DAVIS ENGINEERING CORPORATION

30 Rockefeller Plaza, New York 20, New York • Circle 6-5650

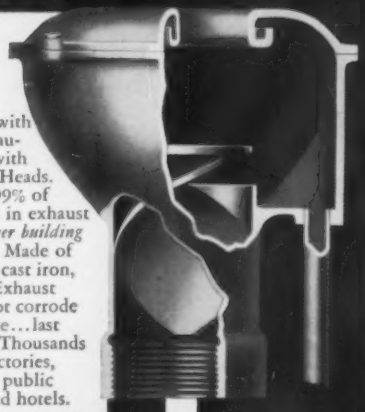
■ Now available with extra-heavy "hex" gripping surface (on most sizes) for fast, easy field use, low-cost Mayco Dielectric Bushings stop damaging electrolysis action before it starts. Made from toughest PLASKON nylon... bright red in color... withstand pressures to 1000 lbs., temperatures to 300° F. Control electrolysis on plumbing, heating and gas applications — wherever dissimilar metals are joined.

Order Mayco Dielectric Bushings from your jobber today... or write:

MAY PRODUCTS, INC. Galesburg, Illinois

Manufacturers of MAYCO Dielectric Fittings — MAYCO Water Softeners

Swartwout
EXHAUST HEADS
slash building maintenance cost



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WE HEAR THAT

Continued

▸ A *RIDGE TOOL CO.* factory trained representative will cover southeastern U. S. with another of the company's "Mobile Demonstration Wagons." Working from a station wagon especially equipped with a portable generator, he will demonstrate the company's complete line of products.

▸ The rebirth and expansion of *SCOVILL MFG CO.*'s tube business is marked by the opening of the company's *SCOVILL TUBE MILLS* in New Milford, Conn. The division begins as a separate and fully integrated operation.

▸ Directors of *FOSTORIA PRESSED STEEL CORP.*, of *CHEMPUMP CORP.*, and of *ZENITH ENGINEERING CORP.* have approved a proposal to merge the three firms. The combined concern would be known as FOSTORIA CORP. and would continue the activities of the present companies.

▸ *AMERICAN AIR FILTER CO.*'s management has been honored by the *AMERICAN INSTITUTE OF MANAGEMENT.* The Institute has certified the company as "Excellently Managed" during 1958.

▸ The new name of *SUNDSTRAND MACHINE TOOL CO.* is *SUNDSTRAND CORP.* The corporation's hydraulics division will now be known as *SUNDSTRAND HYDRAULICS.* ⧺

for

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JANUARY DIRECTORY ISSUE

Your job will be a lot easier if you'll keep this January Directory issue of Heating, Piping & Air Conditioning available for handy reference. It's one of your most valuable tools — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the blowers, traps, boilers, fittings, specialties of all kinds, etc., you need — and where they're located. They're identified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference. Keep it handy . . . it's a time saver.

Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

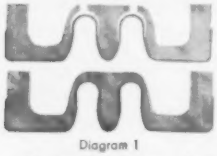

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3" to 72" made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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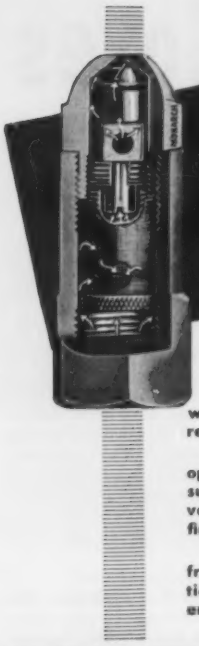
BADGER S·R EXPANSION JOINTS



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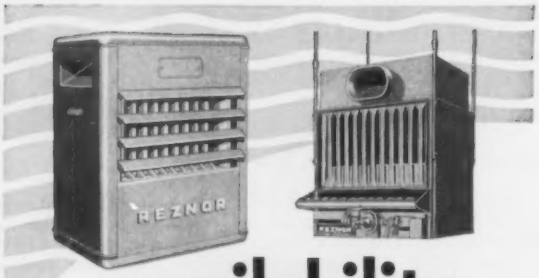

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MEETINGS & CONVENTIONS

1959

JUNE 14-19—*Electrical Precipitation Seminar*, Pennsylvania State University. Information: Extension Conference Center, The Pennsylvania State University, University Park, Pa.

JUNE 15-17—*American Nuclear Society*, annual meeting. Gatlinburg, Tenn. Information: American Nuclear Society, P. O. Box 963, Oak Ridge, Tenn.

JUNE 15-26—*Fundamentals of Welding Engineering*, conference course. Information: W. L. Green, Dept. of Welding Engineering, Ohio State University, 190 W. 19th Ave., Columbus 10, Ohio.

JUNE 21-26—*American Society for Testing Materials*, annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. American Society for Testing Materials, 1916 Race St., Philadelphia 3.

JUNE 22-24—*American Society of Heating, Refrigerating and Air-Conditioning Engineers*, annual meeting. Lake Placid Club, Lake Placid, N. Y., American Society of Heating, Refrigerating and Air-Conditioning Engineers, 62 Worth St., New York 13.

JUNE 22-26—*Air Pollution Control Association*, annual meeting, with technical sessions and exhibits. Hotel Statler, Los Angeles. Air Pollution Control Association, 4400 Fifth Ave., Pittsburgh 13.

JUNE 22-26—*Short Course in Corrosion Reactions and Corrosion Control.* Massachusetts Institute of Technology, Cambridge, Mass. Presented in cooperation with the National Association of Corrosion Engineers. Information: James M. Austin, Director of Summer Session, Massachusetts Institute of Technology, Cambridge 39, Mass.

SEPT. 21-25—*Instrument Society of America*, instrument-automation conference and exhibit. International Amphitheater, Chicago. For information contact: Fred J. Tabery, exhibit manager, Instrument-Automation Conference and Exhibit, 3443 S. Hill St., Los Angeles 7.

SEPT. 28-*OCT.* 1—*American Welding Society*, fall meeting. Sheraton-Cadillac Hotel, Detroit. American Welding Society, 33 W. 39th St., New York 18.

SEPT. 29-*OCT.* 1—*Western Region Conference of the National Association of Corrosion Engineers*, an-

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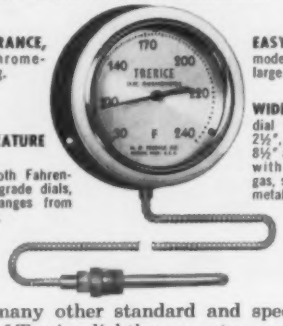

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MEETINGS & CONVENTIONS

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1959

nual meeting. Bakersfield Inn, Bakersfield, Calif. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

OCT. 5-7—*American Gas Association,* annual convention. Conrad Hilton Hotel, Chicago. American Gas Association, 420 Lexington Ave., New York 17.

OCT. 5-8—*Northeast Region Conference of the National Association of Corrosion Engineers,* annual meeting. Lord Baltimore Hotel, Baltimore, Md. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

OCT. 20-22—*North Central Region Conference of the National Association of Corrosion Engineers,* annual meeting. Cleveland. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

NOV. 2-5—*Air Conditioning and Refrigeration Institute,* 11th exposition. Atlantic City Auditorium, Atlantic City, N. J. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C.

NOV. 16-20—*Corrosion Short Course,* annual general Florida conference. Key Biscayne Hotel, Miami. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

1960

Feb. 1-4—*2nd Southwest Heating and Air Conditioning Exposition.* Memorial Auditorium, Dallas. Under auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, in conjunction with the newly merged society's semi-annual meeting, also in Dallas. For information contact: International Exposition Co., 480 Lexington Ave., New York 17. ASHRAE headquarters: 62 Worth St., New York.

MARCH 14-18—1960 *Corrosion Show.* Memorial Auditorium, Dallas. Under the auspices and in conjunction with annual conference of the National Association of Corrosion Engineers. Information: R. W. Huff, Jr., Exhibition Manager, 1061 M & M Bldg., Houston 2. ≠

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THERMODYNAMICS—By Gordon J. Van Wylen. 567 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $7.95.

AIR POLLUTION CONTROL—By W. L. Faith. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $8.50.

SYMPOSIUM ON RADIOACTIVITY IN INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER, STP 235. 76 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2.50.

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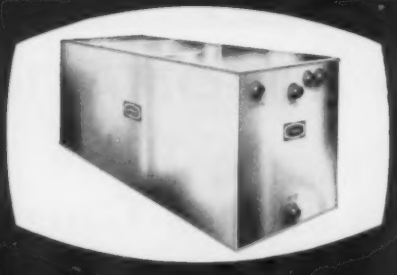

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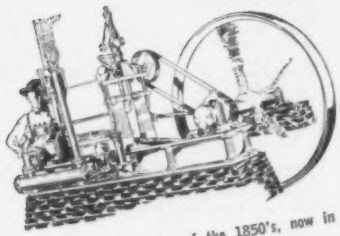
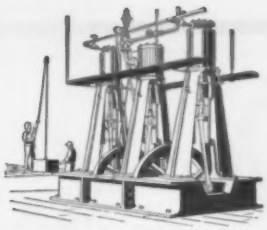
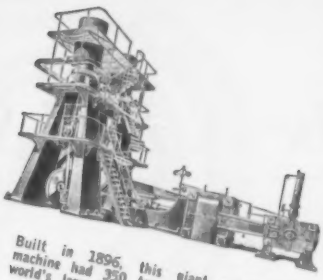


Frick steam engine of the 1850's, now in the Ford Museum.



Ammonia compressor built in 1883.



Built in 1896, this giant refrigerating machine had 350 tons capacity—then the world's largest.

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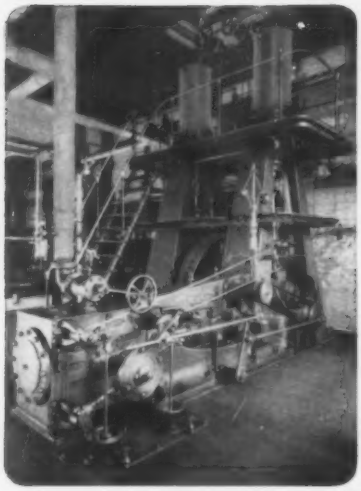

Steam-driven compressor installed in 1887 at Gipps Brewery, Peoria, Ill. In service 60 years.

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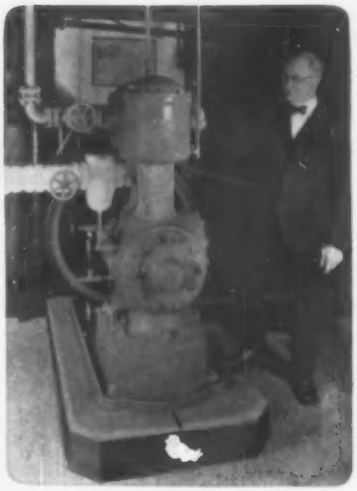

This enclosed type ammonia compressor introduced in 1915, was used at Spath's Market, Portland, Ore., until the 1940's.

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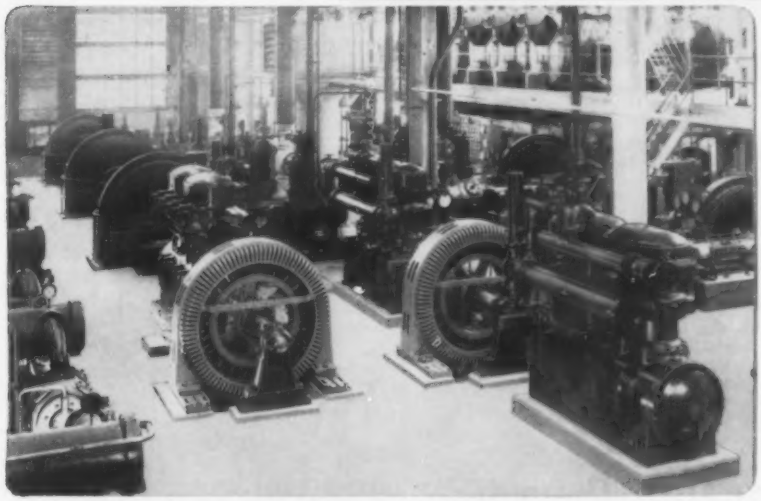

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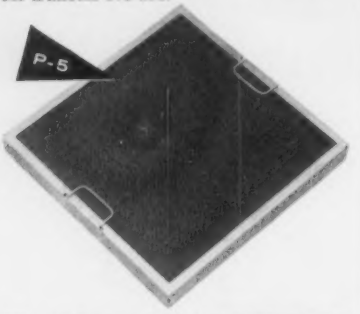

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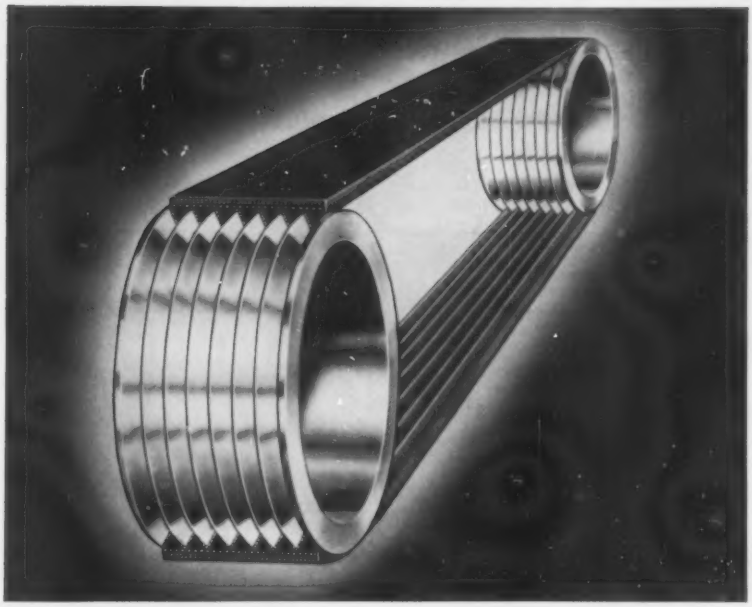
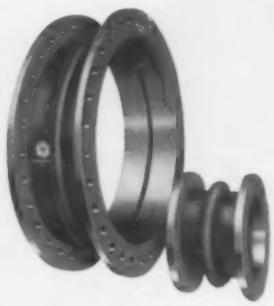


SMOOTHER, QUIETER, COOLER RUNNING

For industrial air conditioning blowers, pumps and compressors—wherever heavy duty power driven equipment is required—*no* drive can deliver as *much* power in as *little* space as Raybestos-Manhattan's patented Poly-V Drive! A single, endless, parallel V-ribbed belt runs on sheaves specially designed to mate precisely with belt ribs. Single unit design permits *narrower* Poly-V sheaves to deliver *equal* power in as little as ⅔ the space of a conventional V-belt drive—or up to 50% *more* power in the *same* space! Space-saving Poly-V Drive reduces shaft overhang . . . eliminates excessive vibration, belt and sheave wear and noise. Poly-V Belt cannot sink into the sheave grooves under shock loads . . . maintains constant speed ratios for smoother, cooler, quieter running performance, *no* load to *full* load.

Major causes of V-drive trouble are engineered *out* of Poly-V. V-belt "length matching" problems are completely eliminated . . . and just *two* Poly-V belt cross sections meet every heavy duty power requirement. Let an R/M representative show you how R/M Poly-V* Drive can give you greater vibrationless power delivery, greater drive dependability for your air conditioning, heating equipment applications. Write for Bulletin M141.

*Poly-V is a registered Raybestos-Manhattan trademark, Patented.



R/M RUBBER EXPANSION JOINTS AND PIPE

Precision engineered expansion joints overcome pipe expansion stress, insulate against noise and vibration, avoid misalignment.

- MAXIMUM RESISTANCE TO SHOCK
- GREATER RECOVERY FROM MOVEMENT
- NO EMBRITTLEMENT WITH AGE
- REQUIRES NO GASKETS
- ABRASION AND CORROSION RESISTANT

CONDOR FLEXIBLE RUBBER PIPE replaces pipe lines subject to noise and vibration. Outlasts iron or steel. No leaky joints at bends. Easy installation. Write for Bulletin M685.

CONDOR V-BELTS

For heavy industrial multiple belt units.

- PRECISION MADE
- SMOOTHEST RUNNING V-BELTS MADE
- MORE GRIP, LESS SLIP
- LONGER, TROUBLE-FREE SERVICE
- LOWER DRIVE COSTS

NEW R/M CX V-BELT*

- EXTREMELY QUIET . . . VIBRATION-FREE
- ONLY FULLY-MOLDED, FULLY-JACKETED NOTCHED V-BELT
- FOR SMALL PULLEYS
- FLEXIBLE, RUGGED, STRONG
- OUTLASTS OTHERS UP TO 8 TO 1
- NO FLEX-CRACKING
- HOLDS SHAPE AND EFFECTIVE LENGTH WITHOUT STRETCH

*Made for original equipment. Patented.

RM 939

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

CONNOR ENGINEERING CORPORATION

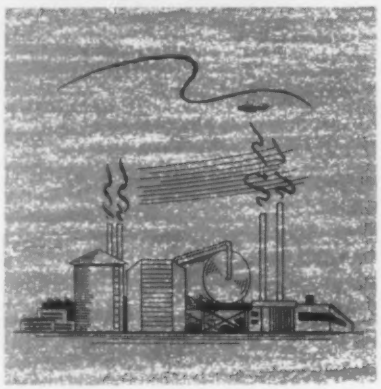
dorex®

Meets Every Demand for PROPER AIR PURIFICATION

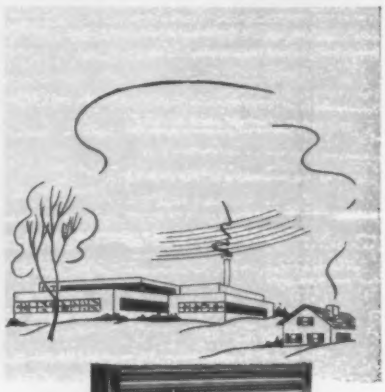
the most complete line of Air Purification equipment available

1—PURIFIES COMBINED RECIRCULATED AND OUTSIDE AIR

2—PURIFIES SEVERELY CONTAMINATED INDUSTRIAL OUTSIDE AIR

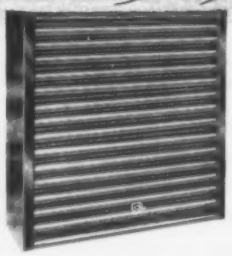


3—PURIFIES COMMERCIALLY CONTAMINATED OUTSIDE AIR (SMOG)



SPECIFICATIONS			
	No. 28	**No. 42**	**No. 52**
Size (Face Dimensions)	24″ x 24″	24″ x 24″	24″ x 24″
Depth (in dir. of Air Flow)	8¾″	8¾″	8¾″
Maximum Capacity	1000 CFM	700 CFM	1000 CFM
Carbon Bed Thickness	½″	¾″	½″
Approx. Weight of Carbon	36 lbs.	45 lbs.	45 lbs.
Resistance*	0.225″ WG	0.285″ WG	0.24″ WG
Efficiency	95%	95%	95%
Net Weight (cell only)	87 lbs.	92 lbs.	97 lbs.
Shipping Weight	110 lbs.	115 lbs.	120 lbs.

*The resistance of Dorex C Cells will not vary provided they are protected against dust accumulation.



THE DOREX NO. 52 CELL... NEWEST ADDITION TO THE COMPLETE DOREX LINE.

You can depend on a specially designed Dorex unit to solve your particular air purification problem . . . whether your problem is 1 . . . 2 . . . or 3.

Dorex specialists, with more than a quarter century of experience and research in design and development of air recovery equipment, make the right recommendation . . . whatever the situation.

Dorex air purification units solve your problem. Dorex *Service Engineers* keep it solved . . . keep your system in continuous operation through a time-proven automatic reactivation-replacement program. Strategically located reactivation stations are maintained throughout the United States and Canada.

With each installation, Dorex assumes responsibility for economical and efficient operation . . . a responsibility lived up to for years for thousands of Dorex users.

For the best in air recovery products, insist on Dorex. Write for recommendations to solve your problem.

CONNOR... for Constant Comfort Conditions

Write for "Air Conservation Engineering"... the authoritative text on air purification.

Also available. New Dorex Bulletin No. 108A

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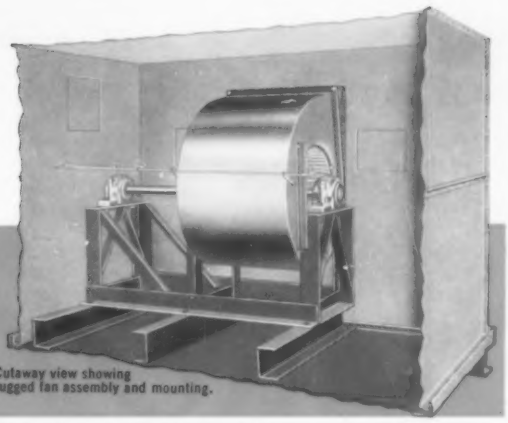
dorex® air recovery

A new pace-setter



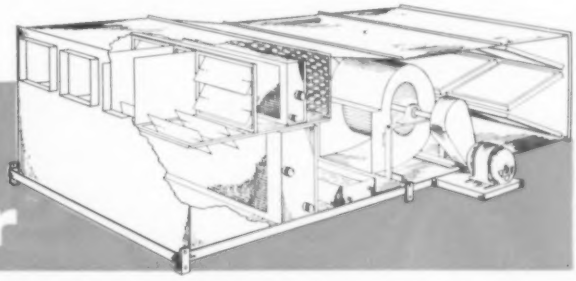
Cutaway view showing rugged fan assembly and mounting.

Clarage Hi-Static Multitherm for High Velocity Air Conditioning Systems

INTRODUCED IN 1954 by Clarage, this new line of Draw-Thru type units fully answers the requirements of conduit type systems where high duct velocities and pressures to 8" static are involved.

FIRST INSTALLED IN 1954 in the Perth Amboy General Hospital, Perth Amboy, N. J. Since then numerous Clarage Hi-Static Multitherms have been specified and used because of stable, efficient operation. Request Bulletin 1312 covering the 7 sizes, capacities 2,500 to 22,000 CFM.

Still a pace-setter



Clarage Blow-Thru Multitherm for Central Station Zone Control Air Conditioning

INTRODUCED IN 1939 by Clarage, the pioneer and perfecter of this type of equipment. A single Blow-Thru Multitherm Unit can handle as many as 8 different zones for different area requirements.

FIRST INSTALLED IN 1940 in the Northern Indiana Brass Co. office building, Elkhart. Over 1000 Clarage Blow-Thru Multitherms have now been installed the nation over—selected because of their unique feature of *mixing* hot and cold air to prevent stratification... their quiet, economical, dependable performance. Request Bulletin 1310 covering the 12 sizes, capacities to 12,000 CFM.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Low Water Cut-offs on Hot Water Boilers?

...the industry has given the answer

Yes, the answer has come from the field . . . from the engineers, contractors and manufacturers. They have seen the logic of installing a water level control on hot water space heating boilers . . . a low water cut-off, or—for even greater precaution—a feeder cut-off combination.

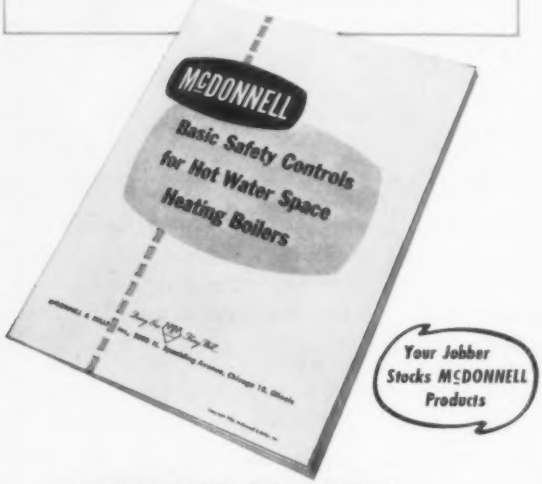
We knew it was a good idea. Expected it to grow and grow. But frankly we have been surprised at how rapidly the heating industry has taken hold of water level control as a logical team mate for an ASME pressure relief valve.

In fact, many local codes now require a low water cut-off, or feeder cut-off combination, on hot water boilers installed in places of public occupancy—including multiple dwelling units.

Notice the diagrams of recommended installations opposite. For more detailed discussion get this booklet that tells the whole story: "Basic Safety Controls for Hot Water Space Heating Boilers."

The What-Why-How in eight interesting pages

Write for Bulletin P-30C



Your Jobber Stocks McDONNELL Products

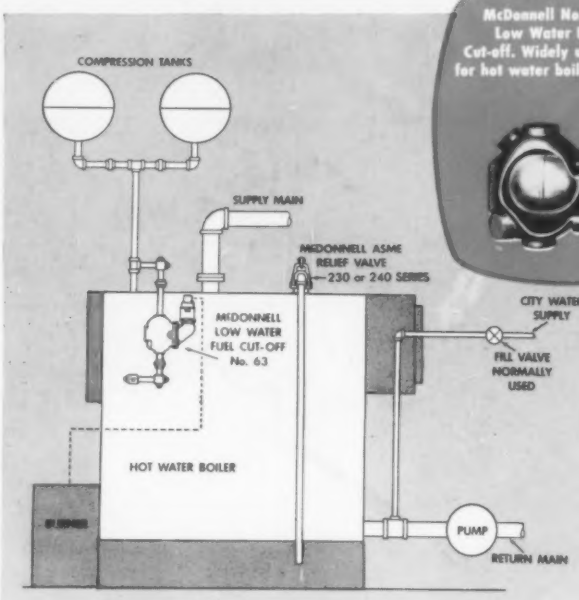
McDONNELL & MILLER, Inc.

3500 N. Spaulding Ave., Chicago 18, Ill.

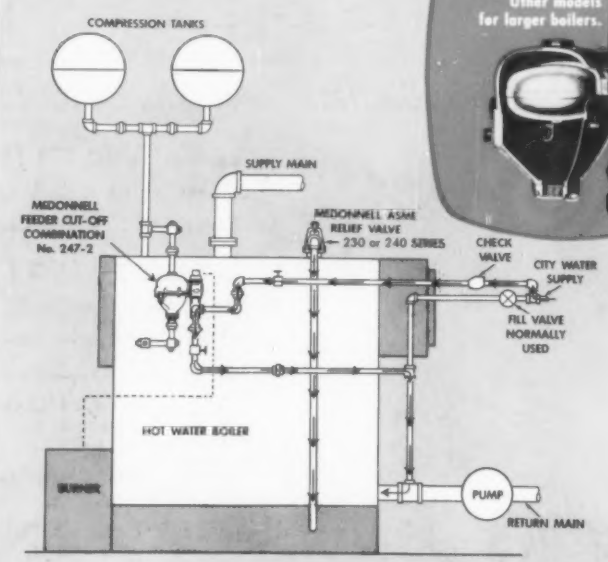
Doing One Thing Well

McDONNELL

Boiler Water Level Controls



1 The essential low water control for a hot water boiler. A McDonnell Low Water Cut-off located above lowest permissable water level; also McDonnell A.S.M.E. Pressure Relief Valve.



2 The safest and most complete control for a hot water boiler. Offers a combination of mechanical and electrical safeguards which is today's best and most complete answer. A McDonnell combination Boiler Water Feeder and Low Water Cut-off; also McDonnell A.S.M.E. Pressure Relief Valve.